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THE ROLE OF NON-GOVERNMENTAL ORGANIZATIONS AND UNIVERSITIES IN INTERNATIONAL SCIENCE AND TECHNOLOGY COOPERATION

HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

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THE ROLE OF NON-GOVERNMENTAL ORGANIZATIONS AND UNIVERSITIES IN INTERNATIONAL SCIENCE AND TECHNOLOGY COOPERATION

TUESDAY, JULY 15, 2008

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:07 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Brian Baird [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
RANKING MEMBER

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Hearing on

The Role of Non-Governmental Organizations and Universities in International Science and Technology Cooperation

Tuesday, July 15, 2008
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Witness List

Dr. Alan Leshner
Chief Executive Officer
American Association for the Advancement of Science

Dr. Michael Clegg
Foreign Secretary
National Academy of Sciences

Dr. William Wulf
Member of the Board of Directors
Civilian Research and Development Foundation

Dr. James Calvin
Interim Vice President for Research
Texas A&M University

HEARING CHARTER

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

The Role of Non-governmental Organizations and Universities in International Science and Technology Cooperation

TUESDAY, JULY 15, 2008
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

1. Purpose

The purpose of the hearing is to examine the role of U.S. non-governmental organizations and universities in international science and technology cooperation, in particular relative to the role of the Federal Government.

2. Witnesses:

- **Dr. Alan Leshner,** Chief Executive Officer, American Association for the Advancement of Science (AAAS), and Executive Publisher of the journal *Science.*
- **Dr. Michael Clegg,** in his capacity as Foreign Secretary, National Academy of Sciences. Dr. Clegg is also Donald Bren Professor of Biological Sciences and of Ecology and Evolutionary Biology at the University of California, Irvine.
- **Dr. William Wulf,** in his capacity as a Member of the Board of Directors, Civilian Research and Development Foundation (CRDF). Dr. Wulf is also AT&T Professor of Computer Science at the University of Virginia and immediate Past President of the National Academy of Engineering.
- **Dr. James Calvin,** Interim Vice President for Research, Texas A&M University. Dr. Calvin is also a Professor of Statistics at Texas A&M.

3. Overarching Questions:

- What are the roles of non-governmental organizations (NGOs) and universities in fostering international science cooperation relative to that of the Federal Government and to each other? What unique strengths does each of the organizations represented at the hearing bring to this effort? What are their respective limitations? How do NGOs and universities coordinate their efforts with the Federal Government and with each other?
- How might the Federal Government take better advantage of science and the U.S. scientific community in pursuing its foreign policy goals and in helping to lead the world toward global solutions for global challenges such as water, climate, energy and infectious diseases?

4. Overview

On April 2, 2008, the Subcommittee on Research and Science Education held a hearing to examine the federal role in international science and technology (S&T) cooperation.[1] Witnesses were invited from the Office of Science and Technology Policy (OSTP), the National Science Foundation (NSF), the Department of State (DOS), and the National Aeronautics and Space Administration (NASA). The research agencies, such as NSF and NASA, support science for the sake of science; that is, they support cooperative research activities that enable U.S. scientists to work with

[1] *http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=2134*

the best scientists and access the best research sites around the world, or that leverage foreign funds to build world class research facilities. However, witnesses agreed that while DOS is responsible for establishing U.S. diplomatic priorities, the research agencies support cooperative S&T activities that may also benefit U.S. diplomatic objectives. Furthermore, OSTP and the research agencies provide intellectual support to DOS on S&T-related issues, and DOS helps the research agencies negotiate formal international S&T agreements. The purpose of the April 2 hearing was to learn about the breadth of U.S. Government sponsored cooperative S&T activities and to examine the extent to which these activities are coordinated or prioritized across the government.

The purpose of this hearing is to examine the role of non-governmental organizations in international S&T cooperation, and the relationship between those organizations and the Federal Government. NGOs and universities play critical roles in promoting and managing U.S. participation in international S&T cooperation. Scientific organizations such as the National Academies and the American Association for the Advancement of Science (AAAS) can mobilize U.S. scientific leadership in a way that the U.S. Government generally cannot, and they can engage in troubled countries where the government has strained or no official diplomatic relations. The U.S. Civilian Research and Development Foundation (CRDF) also has more flexibility and credibility than official government representatives in certain regions. Organizations such as the Institute for International Education (IIE) and NAFSA: Association of International Educators promote the open exchange of students and scholars across borders. Universities not only welcome foreign students and scholars to their campuses and send their own students and scholars abroad, they are increasingly experimenting with satellite campuses in regions such as the Middle East and in educating a more globally aware student body. Finally, a number of private foundations fund certain science or technology based initiatives, typically in agriculture and/or health, including Gates, Sloan, Carnegie, and Rockefeller. One much smaller foundation, the Lounsbery Foundation, provides seed funding to help jump-start international cooperative S&T activities not related to agriculture, health or other areas not supported by the big foundations.

5. NGO Activities in International S&T Cooperation

The National Academies (comprised of the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine) have a long history of engagement in global S&T issues, run primarily out of the Policy and Global Affairs Division. The National Academies are represented at the 18-Member InterAcademy Council and the 98-Member InterAcademy Panel, both of which are global networks of national and/or regional science academies that take on global S&T challenges. The Council produces reports for policy-makers on global issues, most recently on a sustainable energy future, whereas the Panel is focused more on capacity building. The National Academies also work on a bilateral basis—for example with China on biosecurity and with Israel and the Palestinian Authority on water issues. They frequently sponsor meetings and workshops to bring together scientists and engineers from different countries but with common interests and challenges. In general, the National Academies have unparalleled credibility and a unique ability to regularly mobilize a global network of scientists and our own scientific leadership in cooperative efforts to address global concerns across the spectrum of S&T issues.

The American Association for the Advancement of Science (AAAS), publisher of *Science* magazine, also has global credibility and name recognition, but does not have the same built-in network of comparable organizations. The AAAS International Office, which has just a handful of staff, supports three strategic goals: international scientific cooperation; capacity-building and workforce enhancements (including increased participation of women in science); and sustainable development. The AAAS Center for Science, Technology and Security also works on a global level to address non-proliferation and arms control. AAAS does not produce reports directly for policy-makers, but it does produce reports for the community that are often of interest to policy-makers. AAAS also facilitates meetings of scientists from around the world, sometimes in partnership with the National Academies. The theme of the 2008 AAAS Annual Meeting was "Science and Technology from a Global Perspective" and among the keynote speakers were the President of the Republic of Rwanda and the Science Adviser to the Secretary of State. As an organization they are making a concerted effort to engage more U.S. scientists in international cooperation.

The U.S. Civilian Research and Development Foundation (CRDF) was authorized by Congress in 1992 (P.L. 102–511) and established by NSF in 1995. CRDF receives support from several foundations and from the U.S. Government—primarily an an-

nual grant from DOS, but also lesser amounts for specific programs from NSF, NIH, and DOD. While CRDF has many different kinds of programs in cooperative science research, education and training, including an industry partnership program, it is perhaps best known for its role in helping to redirect weapons scientists in the Former Soviet Union (FSU). CRDF, as an NGO without the constraints of official government-to-government diplomacy and bureaucracy, became very adept at enlisting FSU weapons scientists in cooperative civilian research with U.S. scientists, and bypassing bureaucracy and corruption on the FSU side to transfer to the scientists the funds necessary to partner in this research. In 2004, CRDF began to expand its reach beyond the FSU to developing countries and troubled regions throughout the world as well as to broaden its expertise to the full range of global S&T challenges.

The international programs and initiatives at Texas A&M University are fairly representative of such programs at research universities across the country. Texas A&M has formal research agreements with more than 130 institutions in 45 countries and enrolls over 4,000 international students from 124 countries. Nationwide, 40.5 percent of the 583,000 foreign students studying in the U.S. in 2006–07 were enrolled in science and engineering programs.[2] The university also welcomes international faculty and scholars for limited term research and education appointments and likewise sends some of its own faculty to foreign universities. The Research and Science Education Subcommittee explored the benefits of the open exchange of science and engineering students and scholars in a February 2008 hearing.[3] In addition, Texas A&M maintains two overseas centers in Italy and in Mexico City and is currently establishing a third one in Costa Rica. Faculty and students have participated in more than 600 research and development projects in over 80 countries. In 2003 the university opened a branch campus in Doha, Qatar, offering four undergraduate engineering degrees. It will soon be establishing research centers and graduate programs at the Qatar campus. The Technology and Innovation Subcommittee examined the specific issue of the internationalization of U.S. universities as part of a July 2007 hearing on the globalization of R&D.[4]

6. Questions for Witnesses

All four witnesses were asked to address in their testimony questions similar to the "overarching questions" listed previously.

[2] "Open Doors Report on International Educational Exchange," Institute of International Education, 2007.

[3] *http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=2064*

[4] *http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=1926*

Chairman BAIRD. Good morning. Our hearing will come to order. I want to thank all our witnesses, my dear friend, Dr. Ehlers, and Members in the audience for being here. This is the third hearing we are having in a series of meetings dealing with the issue of international scientific collaboration and what some have called scientific diplomacy, the idea that scientific exchanges can go a long way towards not only advancing science itself but advancing international relationships. Both Dr. Ehlers and I are very passionate about this, both of us trained as scientists, and having had the privilege of meeting people from around the world who have been impacted by collaborative exchanges, we place a high value on this.

In the past, we have heard from government agencies, and today we will hear from three non-governmental organizations that engage in scientific diplomacy and from a university that supports research and education partnerships, not just across its southern borders but halfway across the world to a country and culture radically different from our own, and we look forward to hearing about that. As important as it is for the U.S. Government to actively engage in science diplomacy, the organizations we are having with us today represented here add unique value to the effort. They are widely known and respected throughout the world. They represent the best of U.S. science and higher education, and they have the flexibility, the connections, and the know-how to engage scientists and pursue good science even in countries where government-to-government relations are tense or limited and in countries with limited S&T capacity of their own.

I had an interesting brief chat with Dr. Leshner earlier about, for example, the challenge in some cultures of producing non-significant results, if that is a failure of experience and failure is not allowed, goodness gracious, how do you do science if you cannot fail?

While I often emphasize the diplomatic benefits of international science and technology cooperation, there are also many compelling reasons for the U.S. public and private sectors alike to make S&T cooperation a national priority. Visit any of the high-tech enterprises in my district and I am sure across the country and you will see they are indeed international endeavors, and bringing people here, sending our people internationally, is an often I think unseen benefit of collaboration.

The major challenges faced by our nation are the major challenges faced by the entire globe, and our country cannot effectively pursue solutions on its own.

So, I look forward to hearing from this very distinguished panel of witnesses about their efforts to promote international science and cooperation as well as their recommendations for how the Federal Government might strengthen its efforts through more effective partnerships with U.S. scientific organizations and research universities.

I will tell you a brief anecdote which others have heard before, but I think it is so compelling that I will tell it often here and it is in visiting Egypt a couple of years ago at an international meeting and meeting a young woman with a head scarf. Actually, not a young woman, she was probably in her late 50's with a head scarf, kind of classic Arabic woman; and when she was introduced

to Howard Berman, he said he was from southern California, a proud fist shot into the air and the woman said, I am a mighty Trojan. She had gotten her doctorate at USC, and she didn't just say I got my doctorate at USC, she had become a mighty Trojan. And that kind of affection and sincere warmth one doesn't take lightly. And it is through scientific collaboration that much of that is achieved.

And so we look forward to our witnesses today, and with that I recognize Dr. Ehlers for opening remarks.

[The prepared statement of Chairman Baird follows:]

PREPARED STATEMENT OF CHAIRMAN BRIAN BAIRD

Good morning. Welcome to this Research and Science Education Subcommittee hearing on *The Role of Non-governmental Organizations and Universities in International Science and Technology Cooperation.*

Three months ago this subcommittee heard testimony from a panel of senior governmental officials representing some of the key federal agencies and offices responsible for supporting and setting priorities for U.S. participation in international science and technology cooperation. In that hearing we learned a little about the breadth of cooperative S&T activities supported by the U.S. Government. We learned that research agencies are largely successful at pursuing international partnerships to further science and the agencies' own domestic missions and that the State Department actively pursues S&T agreements to further its foreign policy goals. However, it seems to me there is room for improved coordination and priority setting across agencies, especially when it comes to leveraging the quality and reputation of U.S. science to further diplomatic goals.

This morning we will hear from three non-governmental organizations that actively engage in science diplomacy, and from a university that supports research and education partnerships not just across its southern borders but halfway across the world to a country and culture radically different from our own. As important as it is for the U.S. Government to actively engage in science diplomacy, the organizations represented here add unique value to this effort. They are known and respected throughout the world. They represent the best of U.S. science and higher education. And they have the flexibility, the connections and the know-how to engage scientists and pursue good science even in countries where government-to-government relationships are tense or limited and in countries with limited S&T capacity of their own.

While I often emphasize the diplomatic benefits of international S&T cooperation, there are many compelling reasons for the U.S. public and private sectors alike to make S&T cooperation a national priority. The major challenges faced by our nation are the major challenges faced by the entire globe, and the U.S. cannot effectively pursue solutions on its own.

I look forward to hearing from this very distinguished panel of witnesses about their efforts to promote international science and technology cooperation as well as their recommendations for how the Federal Government might strengthen its efforts through more effective partnerships with U.S. scientific organizations and research universities.

Mr. EHLERS. Thank you, Mr. Chairman. First, my apologies for being a bit late. We were trying to solve the Fannie Mae and Freddie Mac difficulties in the space of 15 minutes. It would have been easier to solve Maxwell's equations.

Today's hearing gives us an opportunity to learn about efforts by non-governmental organizations and universities in science diplomacy around the world. The federal agencies have a responsibility in this area, of course, as we learned in a previous hearing, but many of the organizations before us today are uniquely positioned to leverage their own strengths at building relationships in science and technology cooperation that transcend literal and figurative borders. Even in times of governmental conflict, relationships built on trust and mutual respect will outlast current frictions.

One of the advantages of being older is to remember, this has all happened before; and I remember during the years of the Iron Curtain, things of that sort, the two things that contributed a great deal to the breaking down of the Iron Curtain were exchanges of cultural activities, primarily musical, but there were some other cultural activities, too, and that broke the ice. But I think what really did make major contributions is the interchange of scientists between the Soviet Union and the West. Both parties, both the American scientists and the Russian scientists, were very anxious to work together. They did not regard this as a political activity, but the net effect on the government of Russia I think was to open the doors even wider because they could learn from us and they did.

This committee knows that the United States will not remain globally competitive in science and technology unless we are able to work with international partners. Utilizing all avenues to strengthen these relationships, public and private, official and non-official, will be critical to our success as a nation. Raising the profile of science and technology is a consistent goal of this committee as well.

I look forward to hearing from our witnesses today about both their successes and challenges. I certainly appreciate your attendance at this hearing, and I am sure we will learn a great deal from you in the experiences you have had; and I can add those to the experiences that I have had working directly in my laboratory with foreign scientists whom I still keep in touch with.

Thank you for being here.

[The prepared statement of Mr. Ehlers follows:]

PREPARED STATEMENT OF REPRESENTATIVE VERNON J. EHLERS

Today's hearing is an opportunity to learn about efforts by non-governmental organizations and universities in science diplomacy around the world. The federal agencies have a responsibility in this area, as we learned in a previous hearing, but many of the organizations before us today are uniquely positioned to leverage their own strengths at building relationships in science and technology cooperation that transcend literal and figurative borders. Even in times of governmental conflict, relationships built on trust and mutual respect will outlast current frictions.

This committee knows that the U.S. will not remain globally competitive in science and technology unless we are able to work with international partners. Utilizing all avenues to strengthen these relationships—public and private, official and non-official will be critical to our success as a nation. Raising the profile of science and technology is a consistent goal of this committee as well.

I look forward to hearing from our witnesses today about both their successes and challenges. Thank you for your attendance.

Chairman BAIRD. Thank you, Dr. Ehlers.

[The prepared statement of Mr. Carnahan follows:]

PREPARED STATEMENT OF REPRESENTATIVE RUSS CARNAHAN

Mr. Chairman, thank you for hosting another important hearing on international science and technology.

As a Member of both the Subcommittee on Research and Science Education and the House Committee on Foreign Affairs, I am particularly interested in the issues before us today. I was pleased to attend our April hearing on the Federal Government's role in science diplomacy; I look forward to learning more about the role of non-governmental organizations and universities as coordinating entities of international science and technology.

It is clear that we can build more positive relationships with other countries through science. We also understand that the U.S. can better affect U.S. national

security and economic interests by helping to build technological capacity in other countries. I am especially interested in how NGOs and universities can help support the Federal Government's efforts to improve relations abroad through science diplomacy and hope that our witnesses today will spend some time on that topic.

I would like to thank today's witnesses, Dr. Leshner, Dr. Clegg, Dr. Wulf, and Dr. Calvin, for coming before the Committee. I look forward to hearing their testimony.

Chairman BAIRD. At this time, I would like to introduce our distinguished witnesses. First, Dr. Alan Leshner is the Chief Executive Officer of the American Association for the Advancement of Science and executive publisher of the journal, *Science.* Dr. Leshner, I would like to say I received your letter. I will be renewing my membership just next week. I truly did. It was in my mailbox last night that my membership to Science is about to expire, so it is on the way, the check is in the mail.

Dr. Michael Clegg is the Foreign Secretary of the National Academy of Sciences. Dr. Clegg is also the Donald Bren Professor of Biological Sciences and of ecology and evolutionary biology at the University of California at Irvine. Dr. Bill Wulf is a Member of the Board of Directors of the U.S. Civilian Research and Development Foundation. Dr. Wulf is also AT&T professor of computer science at the University of Virginia and the immediate past president of the National Academy of Engineering. Dr. James Calvin is the Interim Vice President for Research at Texas A&M University. Dr. Calvin is also professor of statistics at Texas A&M.

As the witnesses all probably know from experience, our spoken testimony is limited to five minutes, but after that, we will have a nice positive exchange of ideas and questions, and we will start then with Dr. Leshner. Dr. Leshner, thank you for being here.

STATEMENT OF DR. ALAN I. LESHNER, CHIEF EXECUTIVE OFFICER, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE; EXECUTIVE PUBLISHER, SCIENCE

Dr. LESHNER. Thank you very much, Dr. Baird, Dr. Ehlers. First of all, thank you both for your membership. We enjoy your participation in our organization. I also wanted to take this opportunity to thank you for holding this hearing and for giving us an opportunity to speak about the critical role that U.S. non-governmental organizations can play in international science and technology cooperation.

Just to be clear, the American Association for the Advancement of Science is the world's largest multi-disciplinary scientific society, and in spite of our name, we are in fact international in membership and character. About 20 percent of our members come from outside the United States.

Our international activities typically support two key objectives. One is helping to build and knit together the global science enterprise and secondly promoting what is called science diplomacy. We at AAAS believe it is incumbent to our mission to build international partnerships that assist other nations as they are becoming integrated into the global science enterprise. We also help developing nations establish the requisite scientific infrastructure so that they may better reap the benefits of science for their societies.

Science diplomacy has as its goal to utilize international scientific collaboration to foster communication and cooperation among the peoples of diverse nations and to promote greater global

peace, prosperity, and stability. I would like to draw a somewhat subtle but I think important distinction between science diplomacy as conducted by governments and science diplomacy as often carried out by non-governmental organizations.

Governments often use science and technology as a diplomatic or foreign policy tool either to help foster another country's development or to increase understanding of U.S. values and ways of doing business. As used by non-governmental organizations, however, science diplomacy typically has been used to maintain communication and cooperation links among the citizens of countries when their governmental relationships might otherwise be strained or limited. Because we believe science diplomacy to be particularly important at this point in world history, I am very pleased to announce today that we at AAAS are creating a new AAAS Center for Science Diplomacy. The Center's over-arching goal is to use science and scientific cooperation to promote international understanding and prosperity. It will provide a forum for scientists, policy analysis, and policy-makers to share information and explore collaborative opportunities.

I also would like to take this occasion to offer some suggestions about steps the government might take to better position the United States in undertaking international science activities.

First, we need to raise the profile of these issues, and I am particularly pleased you are having this hearing. We need to raise the profile of these issues to the government, to the public, and to the scientific community itself. I do hope that other Congressional committees, particularly those dealing with foreign relations, will work jointly with you to continue the discussion through, for example, additional focused hearings. As just one example of a topic of a hearing might be to look at the mechanisms the State Department could use to evaluate more effectively the science and technology cooperation agreements that the United States has with other countries, particularly in terms of their follow-on activities and their long-term impacts over time.

We also believe that there are steps that might improve the effectiveness of the international programs of U.S. governmental research agencies. One concern I have long had is that some agencies are limited by statute in what they can do because they are not allowed to pay the cost for foreign participants. We believe this limitation can impede the ability of the programs to achieve their overarching goals.

In the realm of science diplomacy, I would encourage Congress and the State Department to consider developing funding mechanisms that could be used to catalyze the types of international science cooperation that are consistent with and reinforce U.S. foreign policy objectives.

And finally, I believe that any efforts to raise the profile on effectiveness of international science requires strong White House leadership, particularly through a presidential science advisor with sufficient rank to work across the entire government. The Office of Science and Technology Policy must also have an associate director who has a clear international mandate if this is going to work. As science and technology are ever more embedded in every aspect of modern life and in every major global policy issue, it is essential

that we determine ways and places where science and technology cooperation might be better incorporated into international relations, not only government to government but critically civil society to civil society. Thank you very much.

[The prepared statement of Dr. Leshner follows:]

PREPARED STATEMENT OF ALAN I. LESHNER

Dr. Baird (Chairman), Dr. Ehlers (Ranking Member), Members of the Subcommittee, thank you for the opportunity to testify on the critical role that U.S. non-governmental organizations play in cultivating, promoting, and coordinating international science and technology cooperation.

The American Association for the Advancement of Science (AAAS) is the world's largest multi-disciplinary scientific society and publisher of the journal, *Science.* Although we were founded in the United States and our name begins with the word "American," that term belies the inherent role that we play in the international arena. Approximately 20 percent of our members are from outside the United States. Moreover, 35 to 40 percent of the research articles we publish in *Science* have authors located outside of the United States.

As the largest general scientific society in the world, our membership allows us both to draw upon scientists from around the world and to access scientists from a very wide range of fields, including the natural, physical and social sciences, as well as engineering and medical science. This depth and breadth of membership provides a massive resource base for action.

AAAS also has an array of well established and recognized program activities in science education, science policy, science communication, and science and national security. This diversity allows us to engage stakeholders from all regions and sectors required to promote and sustain a robust dialogue with the global scientific community.

Over the years, AAAS has worked hard to broaden its efforts to advance science internationally through a range of meetings and education exchange activities. AAAS's portfolio of programs, publications and members are critical to our efforts to build coalitions among other science organizations, non-governmental organizations (NGOs) and international governments for addressing a wide range of science-society issues and for providing a framework for our broader international efforts. As a AAAS Board of Directors' resolution states, "science is often a means to bridge the political chasm that divides nations." It is a sentiment that is embodied in all of AAAS's international interests and is echoed in our Mission "to advance science and serve society throughout the world."

AAAS International Goals and Missions

While AAAS's international activities typically involve convening special workshops or fostering educational exchanges, our projects can best be characterized as supporting two key and mutually reinforcing objectives:

- Helping to build and knit together the global science enterprise
- Promoting what is called science diplomacy

Building a Global Science Enterprise

Science is by definition global in scope and application—it knows no borders, is not constrained by geography, and no one country has a monopoly on it. Advancements in astronomy, mathematics, biology and medicine can find their roots in a rich history of scientific inquiry, discovery, and the sharing of knowledge whether from Meso-America, the Middle-East, or Europe.

That said, the United States has invested in a rich portfolio of basic and applied research across a diverse spectrum of disciplines, established a higher education system that is envied around the world, and developed a robust scientific infrastructure. Because of these investments, our national science and technology activities are at the very forefront of the world's scientific enterprise. These investments have also greatly benefited human health and well-being, increased standards of living and economic growth, and helped build an informed democratic society.

Because of our international character, we at AAAS believe it is both our mission and a great opportunity to build international partnerships that assist other nations as they begin to become integrated into the global science enterprise. In support of our objective "to serve society," we help developing nations establish the requisite scientific infrastructure in order that they too may better reap the benefits of

science as a basis for both their own scientific advancement and their economic and social development.

Two recent examples of such international efforts include:

Women Leaders in Science and Engineering Conference. AAAS worked in collaboration with the U.S. Department of State and the Government of Kuwait to organize the Women's Leaders in Science and Engineering Conference in Kuwait City in 2007. AAAS was able to assemble a delegation of U.S. women scientists and engineers along with nearly 200 female scientists representing the 22 Arab countries. The conference allowed international scientific peers to share experiences and lessons learned in mentoring, scientific publishing and academic leadership. Beyond building practical skills, the conference also provided a critical opportunity for networking and building relationships for potential collaborations in the future; not only between the U.S. and Arab nations, but among the Arab nations present.

Research Integrity Workshop in China. Last September, AAAS conducted a workshop in collaboration with senior members of the Chinese scientific research and policy community on the subject of research integrity and misconduct. The assembled U.S. delegation included journal editors, former university presidents, and government officials. Chinese delegates include presidents of their universities and leaders of government agencies with responsibilities for science and technology. Because integrity and trust are so critical to scientific research and collaboration, this type of dialogue provided a valuable framework for future partnerships and the further development of China's own standards for the ethical conduct of scientific research.

Science Diplomacy

AAAS's second major objective is to act as a catalyst for what is called "science diplomacy." The over-arching goal of science diplomacy is to use international scientific cooperation to foster communication and cooperation among the peoples of diverse nations and to promote greater global peace, prosperity and stability. Science diplomacy is receiving more and more attention in both the scientific and international relations community.

It might be useful here to draw a somewhat subtle distinction between science diplomacy as conducted by governments and science diplomacy as carried out by non-governmental organizations. As emphasized in a recent Congressional Research Service Report to the Congress,[1] science and technology can be used very effectively by government agencies as a diplomatic or foreign policy tool either to help foster another country's development or to increase understanding of U.S. values and ways of doing business. As used by non-governmental organizations, science diplomacy has typically been used to maintain communication and cooperation links among the citizens of countries when their governmental relationships might otherwise be strained or limited.[2] In addition, non-governmental science diplomacy can help build relationships among civil society entities to foster closer people to people relationships whether governmental relationships are good or strained. From my point of view, governments should be interested and supportive of all of these forms of science diplomacy.

Perhaps the most well known example of the success of science diplomacy is the scientific exchanges that took place between the U.S. and the former Soviet Union throughout the Cold War years. These engagements not only helped advance fundamental scientific research, but they also were critical for reinforcing trust between two nations with tense official relationships. In fact in many instances, it provided the only relationship between the two.

AAAS believes this use of scientific collaboration and communication is essential both to the advancement of science and its use for the benefit of our global society. For these reasons I am very pleased to announce today the creation of a new AAAS Center for Science Diplomacy.

The Center is to be guided by the overarching goal of using science and scientific cooperation to promote international understanding and prosperity. It approaches this goal by providing a forum for scientists, policy analysts and policy-makers through which they can share information and explore collaborative opportunities. We are particularly interested in identifying opportunities for science diplomacy to serve as a catalyst between societies where official relations might be limited, and to strengthen existing partnerships in science and technology.

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[1] Stine, D.D., "Science, Technology, and American diplomacy: Background and Issues for Congress," Congressional Research Service, May 22, 2008.

[2] Lord K.M. and Turekian V.C., "Time for a New Era of Science Diplomacy," *Science,* February 9, 2007: Vol. 315 no. 5813, pp. 769–770.

The Center's initial activities will focus on:

- Analyzing current and past domestic and international science diplomacy efforts and deriving lessons learned from those that have succeeded;
- Characterizing the major barriers to successful science diplomacy, such as educational and human resource issues, funding problems, or other policy issues; and
- Leveraging existing and building new partnerships with appropriate stakeholders in both the scientific and the international affairs communities to develop new initiatives and projects and expand ongoing successful ones.

Constraints on AAAS Programs

AAAS faces the same dilemmas that the U.S. Government faces: how best to balance domestic versus international interests, and how best to balance short-term versus long-term goals. International cooperation takes time to develop and nurture, particularly if it requires infrastructure development in one of the cooperating countries. The impacts of science diplomacy also can take a long time to be realized, since the scientific work must be done and trust must be nurtured over time.

Both collaboration and diplomacy require clear time commitments, and we are limited by the ability of our scientific members to take time from their own research careers to share their expertise and build the necessary relationships. We are fortunate at AAAS, because we can draw upon a very large membership of notable scientists that have both an eager interest in and the necessary experience of working internationally. But that is not always enough. Many large scientific organizations, not only those represented here today—CRDF, AAAS, and the Academy—assist scientists in some capacity to participate in the range of international activities that our organizations sponsor. By collaborating and supporting one another, our organizations are able to maximize the quality of international endeavors, while minimizing the resources required.

Some Potential Government Activities

I will conclude by identifying some possible steps the government might consider in order to better position the United States in undertaking international science activities.

First, we need more efforts like this hearing to raise the profile of these issues, to the government, to the public and to the scientific community. I hope that other committees, particularly those dealing with foreign relations, will work jointly with the Research and Science Education Subcommittee to continue the discussion of the importance of international scientific cooperation and science diplomacy as tools in facilitating international peace, prosperity and security, and build upon the efforts that you have already launched.

An example of a topic that could be explored in a joint hearing might be mechanisms to assist the State Department in the development of better strategies for evaluating science and technology cooperation agreements. Too often the signing of these agreements seems to be an end to the process rather than the start of a long-term, strategic relationship.

Moreover, an analysis could be undertaken jointly by the scientific community and the international relations community to provide guidance for more strategic use of these agreements. This guidance could serve not only to help foster international scientific collaborations and overall relationship building, but also for addressing the many societal challenges we face, such as sustainability, climate change, health, etc.

I also believe there are steps that might improve the effectiveness of the international programs of U.S. governmental research agencies. One concern is that some agencies may be limited by statute in their ability to use federal funds to support international activities because they are not allowed to pay the costs for foreign participants. Many agencies, of course, do participate in joint international projects (e.g., the Space Station), but many still are unable to use their budgets to help pay any of the costs for foreign participation. Although we do agree with the view that U.S. taxpayer funds should be used primarily to support American science, there are instances, such as in international science development activities, where this limitation impedes the ability of the programs to achieve their goals. Specifically, many countries simply cannot afford to support their side of the collaboration, and therefore the collaboration is doomed before it has begun. It is worth noting that the European Commission 7th Framework Program includes a new policy that allows non-European institutions to apply for research funding.

In the realm of science diplomacy, I would encourage Congress and the State Department to organize a workshop or roundtable of relevant stakeholders from the

scientific and international affairs communities to look at ongoing efforts and analyze the possibility of establishing new funding mechanisms to catalyze the types of international science cooperation that are consistent with and reinforce the foreign policy objectives of the United States.

Finally, I believe that any efforts to raise the profile and effectiveness of international science require strong White House leadership, mostly likely through a Presidential Science Advisor with sufficient rank to work across the government, most likely the rank of Assistant to the President. Furthermore, the Office of Science and Technology Policy must also have an associate director who has a clear international mandate and the ability to work with the State Department and the National Security Council on issues of international science cooperation.

As science and technology are ever-more imbedded in every aspect of modern life and in every major global policy issue, it is essential that all relevant parties—the Executive Branch, Congress, scientific organizations and their members, international think tanks, foundation leaders, and others, work together in a deliberative manner to determine ways and places where science and technology cooperation might be better incorporated into international relations, not only government to government, but critically, civil society to civil society.

APPENDIX A

American Association for the Advancement of Science (AAAS)

The American Association for the Advancement of Science (AAAS) is the world's largest general scientific society, and publisher of the journal, *Science* (*www.sciencemag.org*). AAAS was founded in 1848, and includes 262 affiliated societies and academies of science, serving 10 million individuals. *Science* has the largest paid circulation of any peer-reviewed general science journal in the world, with an estimated total readership of one million. The non-profit AAAS (*www.aaas.org*) is open to all and fulfills its mission to "advance science and serve society" through initiatives in science education, science policy; international programs; and an array of activities designed both to increase public understanding and engage the public more with science.

APPENDIX B

BIOGRAPHY FOR ALAN I. LESHNER

Alan I. Leshner is Chief Executive Officer of the American Association for the Advancement of Science (AAAS) and Executive Publisher of its journal, *Science.* From 1994 to 2001, Dr. Leshner was Director of the U.S. National Institute on Drug Abuse at the National Institutes of Health (NIH), and from 1988 to 1994 he was Deputy Director and Acting Director of the National Institute of Mental Health. Prior to that, he spent nine years at the National Science Foundation, where he held a variety of senior positions, focusing on basic research in the biological, behavioral and social sciences, on science policy and on science education. Dr. Leshner began his career at Bucknell University, where he was Professor of Psychology. His research has focused on the biological bases of behavior, particularly the role of hormones in the control of behavior. Dr. Leshner is an elected member of the Institute of Medicine of the National Academy of Sciences, and an elected fellow of the AAAS, the American Academy of Arts and Sciences, and the National Academy of Public Administration. He has received numerous awards form both professional and lay groups for his national leadership in science, mental illness and mental health, substance abuse and addiction, and public engagement with science. He received an A.B. degree in Psychology from Franklin and Marshall College and M.S. and Ph.D. degrees in Physiological Psychology from Rutgers University. He also has been awarded six Honorary Doctor of Science degrees.

Chairman BAIRD. Thank you, Dr. Leshner. We have been joined by Mr. Bilbray from California. Thank you, Mr. Bilbray, for being here.

Dr. Clegg.

STATEMENT OF DR. MICHAEL T. CLEGG, FOREIGN SECRETARY, NATIONAL ACADEMY OF SCIENCES, THE NATIONAL ACADEMIES

Dr. CLEGG. Chairman Baird, Ranking Member Ehlers, and distinguished Members of the Subcommittee, thank you for this opportunity to discuss international science, technology, and health cooperation. I use the abbreviation STH to refer to science, technology, and health.

I am Michael Clegg, Foreign Secretary of the National Academy of Sciences. The National Academy of Sciences is a merit-based organization that elects outstanding scientists for membership and includes the Nation's scientific leadership. The U.S. Congress chartered the Academy in 1863 with the explicit mission of providing STH advice to the U.S. Government when asked.

Now, I would like to address your questions directly. Why did the Academies promote international science cooperation?

Science is a global activity, was a global activity long before the invention of the term globalization because the advancement of sciences and the issues and challenges of STH programs are predominantly global in nature. Science is increasingly trans-border and global in its conception, exploration, and application. It is thus in the vital interest of the U.S. science community and more broadly U.S. society, to maintain close linkages with science communities throughout the world.

Mr. Chairman, we believe that our organization, together with its sister academies, the National Academy of Engineering in the Institute of Medicine, and Allied Science NGOs like the AAAS and the major disciplinary science societies bring unique strengths to international science cooperation.

Let me illustrate this point with three case studies. Beginning early in the 1980s, the U.S. National Academy of Sciences established a standing committee on international security and arms control that worked with scientists in the Soviet Union and later in Russia on issues of nuclear stability, arms control, and non-proliferation. The initial work was aimed at building mutual trust and respect, but ultimately this effort matured into a dialogue that was central to later arms reduction agreements. Current work with the Russian Academy focuses on topics such as the international nuclear fuel cycle, international nuclear security environments, and beyond cooperation with Russia we convened dialogues with India on Indo-U.S. cooperation in international security issues and we convened a series of U.S.-China engagements on security-related questions.

Let me now turn to a second example, that is, creating bridges of cooperation in areas of conflict. We have an ongoing program of cooperation with the Academies of the Middle East whose effort included a project on water futures in the Jordan Valley conducted jointly with the Israeli and Palestinian Academies and with the Higher Council of Jordan that resulted in a joint report entitled Water for the Future.

This work has now matured into a series of joint activities that include projects on micro-nutrient deficiencies, water resources, renewable energy, pollution, and land degradation and science education. An organization has been created to implement these pro-

grams provisionally named the Association of Middle Eastern and U.S. National Academies of Sciences.

Why are the U.S. Academies seen as effective conveners of activities in the Middle East? The principal answer is that the U.S. scientific community is held in high esteem by all the societies of this conflicted region of the world. This respect for U.S. science institutions is based on widespread admiration for American accomplishments in STH fields, and it opens doors that might otherwise be closed.

The third example comes from Africa where five years ago we initiated a program of institutional development funded by the Bill and Melinda Gates Foundation to build a capacity of African Science Academies to provide independent evidence-based advice to governments and countries with an emphasis on health needs. The principal objectives of the initiative are to help academies establish sound advisory processes and to foster and sustain a relationship between the academy and its government.

What are the unique strengths of Academies? First, the high esteem accorded U.S. science by the rest of the world. International polling reveals that attitudes toward U.S. science are more positive than towards any other aspect of U.S. society. This attitude is especially pronounced in Islamic countries.

Second, the Academies represent the leadership of U.S. science and as such represent the human face of U.S. scientific achievement. This enables engagement in cooperative work aimed at shared goals in all regions of the world.

Another strength is that the Academies and other non-governmental organizations such as the AAAS can mobilize the U.S. scientific community on urgent issues. And third and perhaps most importantly is the ethic of science. The Academies represent a scientific approach to problem solving, achieving national economic goals, and peaceful competition. A major aspect of our international program is to strengthen education and training and to empower science communities to be more effective in engaging national policy-makers and the public, thereby transmitting this problem-solving ethic to other societies, especially in the developing world.

How might the Federal Government take better advantage of science and the U.S. scientific community? The U.S. Federal Government has great influence in the world owing to the scale of the U.S. economy and owing to the widely admired egalitarian ideals and aspirations of U.S. society. This provides substantial leverage to achieve constructive solutions to global problems. Unfortunately, the U.S. has not always made full use of these assets.

The U.S. has allowed its investments in international STH to decline. Take investments through USAID as an example. An Academies report published in 2006 and undertaken at the request of the USAID administrator found that STH competencies in USAID have declined substantially. The report makes a series of recommendations on how to rebalance the USAID competencies in STH to increase the effectiveness of USAID programs. A very positive step has been the creation of the Office of Science and Technology Advisor for the Secretary of State and the naming of that same individual as advisor to the administrator of USAID.

In its May 2007 strategic plan, the Department of State and USAID established an important set of realistic STH diplomatic strategies. However, these must be seen against inadequate on the part of the Department of State or inadequate and declining on the part of USAID STH capabilities.

Many of the leaders of science in other parts of the world have had significant experience in U.S. research intuitions as students or as research visitors, echoing a point made by Chairman Baird. Those with direct knowledge of our country and its culture are frequently willing partners for further engagement owing to positive feelings about their experiences with U.S. science institutions specifically and U.S. society generally. Regrettably, the cadre of international scientists with direct knowledge of the U.S. is declining. The reasons are many, but two are visa policies that inhibit applications to U.S. institutions and dramatic erosion of broad-based U.S. Government programs for international fellowships.

The Academies' report cited above found that there has been a more than 10-fold decline in the number of USAID financed graduate students from developing countries at U.S. universities. The report makes the strong recommendation that USAID revitalize its investments in human resources based on historical experience. It is clear that a modest investment in fellowships will bring large returns to future generations.

Now, I see I am running out of time, so let me just summarize the last couple of points. Why is it that many federal agencies, USAID, EPA, have science programs with international dimensions, but they could benefit from more explicit instructions and advice from the Congress on how to implement those international responsibilities.

Let me just then conclude by saying that major opportunities to capitalize on U.S. strengths are ignored. To ensure a better future, we must make effective use of all of our nation's assets. Modest investments in international science diplomacy can leverage the enormous asset represented by the U.S. STH communities.

[The prepared statement of Dr. Clegg follows:]

PREPARED STATEMENT OF MICHAEL T. CLEGG

Chairman Baird, Ranking Member Ehlers, and distinguished Members of the Subcommittee, thank you for this opportunity to discuss international science, technology and health (STH) cooperation. I am Michael Clegg, Foreign Secretary of the National Academy of Sciences. The National Academy of Sciences, together with the Academy of Engineering and the Institute of Medicine, (collectively referred to as "The Academies") are non-governmental organizations whose members are elected on the basis of STH leadership.

The U.S. Congress chartered the National Academy of Sciences in 1863 with the explicit mission of providing STH advice to the U.S. Government when asked. Over the years, as the demand for advice expanded and as the U.S. STH community grew in size and complexity, the National Research Council (NRC) was established to administer the advice function. Later the National Academy of Engineering (NAE) and the Institute of Medicine (IOM) were organized under the original charter of the National Academy of Sciences. Today's organization provides advice to government and the public on a wide variety of issues ranging from climate change to bacterial threats, from energy futures to emerging diseases, from food security to building effective science education programs, from challenges of mega cities to the control of weapons of mass destruction.

Why do the National Academies promote international science cooperation?

The Academies are engaged with counterpart STH communities around the world and have a long history of working with international partners in addressing the STH based challenges facing the world. From its inception in 1863, the U.S. National Academy of Sciences has elected outstanding scientists from outside the United States as Foreign Associates, thus recognizing the important contributions of foreign scientists to progress in all fields. In today's world, science is increasingly trans-border and global in its conception, exploration, and application. It is thus in the vital interest of the U.S. science community, and more broadly of U.S. society, to maintain close linkages with science communities throughout the world. Because our organization includes the leadership of science from around the globe, we are uniquely positioned to promote international science cooperation and to facilitate the provision of scientific evidence to policy-makers on a global basis. We are also uniquely positioned to use science as a means of building bridges between societies in conflict and as a means of facilitating international STH collaborations.

Science was a global activity long before the invention of the term "globalization" because the issues and challenges of STH programs are predominantly global in nature. The Academies often include foreign participants in our work, because access to foreign expertise is increasingly relevant for all U.S.-based institutions. The inclusion of global dimensions improves the quality, depth, and accuracy of our studies and reports.

What are the specific goals of the Academies' international programs?

Based on our experience and capacity as an advisor to our own government and society, three broad themes of the Academies' international programs, have emerged: They are: (1) improving global sustainability and health. (2) Enhancing national and international security through increasing pathways of communication. And, (3) enhancing human and institutional capital as a route to economic development and equity. I will briefly describe several selected activities to illustrate the Academies' international programs relevant to these themes.

Improving global sustainability and health: The Academies have had a long engagement with international partners on issues of sustainability and health. One of the major global sustainability issues that demand international S&T cooperation is that of water resources. Many parts of the world, including parts of the United States, face uncertain water futures and it is imperative to develop S&T based solutions for water management issues. In this context, the NRC produced a comprehensive report, together with the Mexican Academy of Sciences, on the issues confronting the Mexico City water supply (*Mexico City's Water Supply: Improving the Outlook for Sustainability*). We have conducted joint workshops on ground water resources in the Yucatan, in the Middle East and in North Africa and we have produced a multilingual information resource on water and health.

A second issue that is particularly crucial at present is that of energy sources and management. The Academies partnered with the Chinese Academy of Sciences to produce a forward-looking report on energy futures in 2000 (*Cooperation in the Energy Futures of China and the United States*) and we have a continuing series of cooperative efforts with the Chinese Academy focused on energy related issues.

Often the Academies work with partners in regions of conflict thereby addressing an important scientific issue while also helping to create bridges of cooperation. Thus, for example, we have an ongoing program of cooperation with the academies of the Middle East. This effort began with cooperation on regional health challenges. It also included a project on water futures in the Jordan Valley, conducted jointly with the Israeli and Palestinian academies and the Higher Council of Jordan that resulted in the joint report entitled *Water for the Future: The West Bank and Gaza Strip, Israel, and Jordan.* This work has now matured into a series of joint activities that include projects on micro-nutrient deficiencies, water resources, renewable energy, pollution and land degradation and science education. An organization has been created to implement these programs provisionally named the "Association of Middle Eastern and U.S. National Academies of Sciences." Our Academies also host a meeting for young and mid-career scientists from Jordan, Israel, Palestine and the United States aimed at sharing research knowledge and framing joint solutions to common problems.

Why are the U.S. Academies seen as effective conveners of activities in the Middle East? The principle answer is that the U.S. scientific community is held in high esteem by all the societies of this conflicted region of the world. This respect for U.S. science institutions is based on a widespread admiration for American accomplishments in STH fields and it opens doors that might otherwise be closed.

Enhancing national and international security through increasing pathways of communication: Beginning in the early 1980s, the U.S. National Academy of Sciences established a standing committee on International Security and Arms Control (CISAC) that worked with scientists in the Soviet Union and later in Russia on issues of nuclear stability, arms control and non-proliferation. The initial work was aimed at building mutual trust and respect, but ultimately this effort matured into a dialogue that was central to later arms reduction agreements. Current work with the Russian Academy focuses on topics such as international nuclear fuel cycle approaches, and the international nuclear security environment. Beyond cooperation with Russia, we convene dialogues in India on Indo-U.S. cooperation in international security issues. We have a series of U.S.-China engagements, one of the few sustained bilateral channels of non-governmental communication on international and regional security issues, with an important set of Chinese scientists, nuclear weapons experts, and policy analysts. We participate in international fora aimed at enhancing biosecurity, both with the international community and in a bilateral context with the Chinese Academy of Sciences.

Enhancing human and institutional capital as a route to economic development and equity: Over the past 15 years a global network of science academies has emerged and become an important venue for coordination among science academies around the world. The network, known as the InterAcademy Panel on International Issues (IAP), has provided a means to coordinate communications and actions with many partners simultaneously. The IAP has established programs on water futures, science education, biosecurity, natural hazards and disasters, and digital access to scientific information. Associations of Engineering and Medical Academies are also active, and cooperation among networks has been established. A second organization, called the InterAcademy Council (IAC) undertakes detailed studies on major global issues. An IAC report released on October 2007 analyzed the global energy transition, earlier reports address the problem of food security in Africa and the importance of women as an under utilized human resource in science. These reports are intended for high-level policy-makers and their dissemination and implementation is being accomplished on a regional basis by networks of academies in Africa, the Americas and Asia. Our Academy played a crucial role in the creation of these networks.

Five years ago we initiated a program of institutional development, funded by the Bill and Melinda Gates Foundation, to build the capacity of African science academies to provide independent, evidence-based advice to their governments and countries, with an emphasis on health needs. The principal objectives of the initiative are to help the academies establish sound advisory processes and to foster and sustain a relationship between the academy and its government and nation such that the academy is regarded as a trusted source of excellent scientific advice.

The initiative supports a variety of activities at the national level. We work intensively with the science academies of Nigeria, South Africa, and Uganda and assist these academies in hiring and training staff, developing infrastructure, and developing and testing different models for policy advice. In addition, we are providing more modest strategic planning grants to the African Academy of Sciences and to the academies of Senegal, Ghana, Kenya and Cameroon, and helping the African Academies to work together.

Partner academies have experimented with convening activities—forums, symposia, and workshops—to gather stakeholders from government, academia, industry, and non-governmental organizations for examination, illumination, and discussion of scientific and policy issues. A few examples of outputs from this work are:

- An influential consensus report of the Academy of Sciences of South Africa entitled *"HIV/AIDS, TB and Nutrition: Scientific Inquiry into the Nutritional influences on Human Immunity with Special Reference to HIV Infection and Active TB in South Africa"* was released in August 2007. This report addresses a widespread controversy over the Nation's AIDS policies, which have for many years emphasized the importance of good nutrition in the fight against poverty, a study committee of 15 multi-disciplinary experts found that neither food nor food supplements, although important for many other reasons, are alternatives to drug therapy in treating those afflicted with HIV/AIDS.
- A Forum on Evidence-based Policy-making in Nigeria.
- The Uganda National Academy of Sciences has established a Forum on Health and Nutrition and has recently released its first major consensus report on *"Approaches to Assessing and Managing Malaria Vector Resistance to Insecticides."*

- The Uganda National Academy of Sciences also recently hosted a workshop *"Promoting Biosafety and Biosecurity within the Life Sciences."*
- A workshop report of the Academy of Sciences of South Africa on water research and management was released in 2007.

Complementary to these activities at the national level, we convene annual conferences, joint learning sessions, and training activities—for networking and shared learning on evidence-based policy advice. The most recent annual conference, *Water and Health in Africa,* was held in Dakar, Senegal. Government officials from 12 African countries participated in the conference. The exchanges and experience from the conference discussions resulted in the drafting and signing of the *Declaration of Dakar:* a document that espouses the use of scientific evidence in policy-making through a process facilitated by science academies.

In the area of human resource development our Academy is an active participant in the IAP global program to improve the quality of science education. During the past year, these efforts have included an IAP sponsored meeting in London on the professional development of science teachers, work with the U.S.–Mexico Foundation for Science (FUMEC) on the fourth biennial international conference on science education—"Science and Well-Being . . . From Amazement to Citizenship"—held in Monterrey, Mexico, in November 2007, a leadership development conference in Nairobi, Kenya, for teacher leaders from 10 African countries and work on the development of an evaluation framework for use in countries committed to improving science education.

What are the unique strengths of the Academies in fostering international science cooperation?

A unique strength of the National Academies in fostering international scientific cooperation is the high esteem accorded U.S. science by the rest of the world. International polling reveals that attitudes towards U.S. science are more positive than towards any other aspect of U.S. society. This attitude is especially pronounced in Islamic countries. As noted elsewhere in this testimony, the Academies represent the leadership of U.S. science and as such represent the human face of U.S. scientific achievement. This enables engagement and cooperative work aimed at shared goals in all regions of the world. A second strength is that The Academies, and other non-governmental science organizations such as the AAAS, can mobilize the U.S. scientific community on urgent issues.

Academies represent a scientific approach to problem-solving, achieving national economic goals, and peaceful competition. A major aspect of our international program is to strengthen education and training, and to empower science communities to be more effective in engaging national policy-makers and the public, thereby transmitting this problem-solving ethic to other societies, especially in the developing world.

What are the limitations of the Academies in fostering international science cooperation?

The Academies do not make policy, but rather provide evidence, analysis and policy options based on our best understanding of science. This means that in most regards, the Academies occupy the role of advisors and not implementers. A second limitation is financial. Most of our international activities are financed by philanthropic foundations or from our own limited endowment pool. The financial base for international work is not adequate to the meet the many urgent needs and opportunities for constructive engagement.

How do you coordinate your efforts with the Federal Government and with those other organizations?

One important component of our interaction with the Federal Government is our direct advisory reports to the State Department and USAID on the role of STH in foreign policy and development assistance. In our own engagement with other countries, we operate within U.S. laws and regulations, which involves communication with the Federal Government when required. But more importantly, the Federal Government is very aware that a successful American engagement with the world must involve many private sector and non-governmental players, and we receive much encouragement from the government in our international activities. One important program of U.S. Embassies abroad is to sponsor extended visits to the U.S. for key (often young) leaders from host countries, including many with interests in STH, and we meet regularly with these foreign visitors. Many U.S. agencies, notably the Fogarty International Center at NIH, and the NSF, but also DOE, EPA, and

others, have active programs for, and interests in, international cooperation, and we have valuable interaction with them. With the support of the NSF, The National Academies provide U.S. participation in the International Council for Science (ICSU), many international disciplinary unions, and IIASA.

Also, our interest in international STH cooperation and in capacity building around the world is similar to that of many non-governmental organizations in the U.S., notably the AAAS. Since these organizations also are led by outstanding American scientists, in many cases individuals involved in their leadership are current or past leaders of The National Academies, and cooperation is natural.

How might the Federal Government, either as a whole or specific to one or more agencies, take better advantage of science and the U.S. scientific community in pursuing its foreign policy goals and in helping to lead the world toward global solutions for global challenges such as water, climate, energy and infectious diseases?

The U.S. Federal Government has great influence in the world owing to the scale of the U.S. economy, and owing to the widely admired egalitarian ideals and aspirations of U.S. society. This provides substantial leverage to achieve constructive solutions to global problems. Unfortunately, the U.S. has not always made full use of these assets. Moreover, the U.S. has allowed its investments in international STH to decline. Take investments through the U.S. AID as an example. An Academies report published in 2006, and under taken at the request of the U.S. AID Administrator, entitled *"The Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development"* found that STH competencies in USAID have declined substantially. The report made a series of recommendations on how to rebalance the USAID competencies in STH to increase the effectiveness of USAID programs.

The creation of the office of Science and Technology Advisor (STAS) for the Secretary of State is an important step forward, as is the recent appointment of the same individual as Science and Technology Advisor to the USAID Administrator. In its May 2007 strategic plan, the Department of State and USAID established an important set of realistic STH diplomatic strategies, however, these must be seen against inadequate (DOS) or inadequate and declining (USAID) STH capabilities. As noted in a recent Congressional Research Service report (*"Science, Technology, and American Diplomacy: Background and Issues for Congress"*), implementation of these diplomatic strategies will require new investments in governmental capabilities, but implementation can also be accelerated by the effective use of non-governmental science organizations.

An important opportunity derives from the fact that many of the leaders of science in other parts of the world have had a significant experience with U.S. research institutions as students or as research visitors. To cite one example, 40 percent of the faculty at Sharif University, Iran's premier science and technology institution, received training in the U.S. During a recent visit to Sharif University, the desire for an expanded engagement with all areas of U.S. science was repeatedly emphasized to the U.S. visiting delegation. This illustrates an experience that is reiterated in all parts of the world—many with direct knowledge of our country and its culture are willing partners for further engagement, owing to positive feelings about their experiences with U.S. science institutions specifically and with U.S. society generally.

Regrettably the cadre of international scientists with direct knowledge of the U.S. is declining, because broad based U.S. Government programs for international fellowships have eroded greatly over the past two decades. The Academies report cited above found that there has been a ten-fold decline in the number of USAID-financed graduate students from developing countries at U.S. universities. The report makes the strong recommendation that USAID revitalize its investments in human resources, by bringing its fellowship programs back to the scale of the 1980s. Based on historical experience, it is clear that a modest investment in fellowships will bring large returns in future generations.

Current visa policies are a further obstacle to scientific exchange. It is important to find an appropriate balance between legitimate national security concerns and other dimensions of our national interest. To quote from the recent CRS report cited above, "As other countries increase their investment in higher education and R&D, the top science and engineering research and facilities may not be in the United States," thus broader engagement is clearly in our national economic self interest. Moreover, other aspects of our national security depend on U.S. international STH engagement, for example in responding to global emerging infectious diseases challenges such as HIV or SARS or avian flu.

The National Science Board (NSB) recently issued a report (*International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise*) that touches many of the themes listed above, including that the U.S. should create a coherent and integrated international science and engineering strategy, balance U.S. foreign and R&D policy, and promote intellectual exchange. These themes emphasizing the critical role of STH in U.S. diplomacy are being reiterated in many fora including these hearings. It seems clear that the time is ripe to make fuller use of U.S. STH assets in achieving national foreign policy goals.

Many of the dozens of federal agencies have core goals to which carefully chosen international cooperation could provide very valuable contributions, and these opportunities are becoming more important as scientific strength is more widely distributed, as economies globalize, and as challenges (related, for example, to aging populations, to water, to global health, to energy and climate change) are increasing understood to have commonalities and/or to require common action. But in general, federal agencies perceive that the option to support international activities is not very clear in their congressional guidance and mandate. Thus, it would be very useful for federal agencies to have congressional guidance that allows them to support and engage in high-value, innovative opportunities for international cooperation.

The points developed above do not speak directly to the question of addressing "global challenges such as water, climate, energy and infectious diseases," but rather address structural impediments to a more effective utilization of U.S. STH assets to achieve national goals. We believe that structural reforms must be the fundamental first step. Once these are accomplished, it will be relatively straightforward to focus U.S. STH strengths, both through direct governmental programs and through the effective use of non-governmental science organizations, on global challenges of sustainability. As noted earlier in this testimony, much is already being done through the global network of academies (IAP) or with important bilateral partners (e.g., China, the Middle East) to focus on sustainability issues, but these efforts are modest compared to the scale of the problems that the world faces.

Thank you again for this opportunity to testify. I would be happy to address any questions the Subcommittee might have.

BIOGRAPHY FOR MICHAEL T. CLEGG

Michael T. Clegg received his B.S. and Ph.D. degrees in agricultural genetics and genetics respectively at the University of California, Davis. In 1972, he joined the faculty of Brown University moving from there to the University of Georgia in 1976. In 1984, he assumed the position of professor of genetics at the University of California, Riverside. He also served as Dean of the College of Natural and Agricultural Sciences from 1994 to 2000 and he is Founding Director of the Genomics Institute at the University of California, Riverside. In July 2004, he joined the faculty of UC–Irvine as the Donald Bren Professor of Biological Sciences.

Clegg's research specialty is population genetics and molecular evolution. His early work in population genetics focused on the dynamical behavior of linked systems of genes in plant and Drosophila populations. During this period, he also contributed to the theoretical study of multi-locus systems employing computer simulations together with the analysis of mathematical models. Later he helped pioneer the comparative analysis of cholorplast DNA variation as a tool for the reconstruction of plant phylogenies. His current work is concerned with the molecular evolution of genes in the flavonoid biosynthetic pathway, the use of coalescent models to study crop plant domestication and the application of molecular markers to avocado improvement.

Clegg was elected to membership in the National Academy of Sciences in 1990 and he was elected a fellow of the American Academy of Arts and Sciences in 1992. He was elected Foreign Secretary of the National Academy of Sciences in 2002 and reelected in 2006. He is an Associate Fellow of TWAS (Academy of Sciences of the Developing World) and a corresponding member of both the Academia Nacional de Ciencias Exactas Fisicas y Naturales and the Academia Nacional de Agronomia y Veterinaria of Argentina. He has also served as President of the American Genetic Association (1987); President of the International Society for Molecular Biology & Evolution (2002); and Chair of the Section on Agriculture, Food and Natural Resources of the American Association for the Advancement of Science (2003).

Chairman BAIRD. Dr. Wulf.

STATEMENT OF DR. WILLIAM A. WULF, MEMBER, BOARD OF DIRECTORS, U.S. CIVILIAN RESEARCH AND DEVELOPMENT FOUNDATION (CRDF)

Dr. WULF. Chairman Baird, Ranking Member Ehlers, and distinguished Members of the Subcommittee, I appreciate the opportunity to testify today on behalf of the Civilian Research and Development Foundation, a.k.a. CRDF. I am fairly new to the board of CRDF, having just joined in February. I was quickly recruited to become Chairman of the Audit Committee, and so I have immersed myself in the organizational, financial, and programmatic activities of the organization, an organization I must say whose mission I believe very deeply in. Nevertheless, let me introduce Cathy Campbell behind me here who is the CEO of CRDF and who will bail me out if I get in over my head during the Q&A.

It is especially appropriate for CRDF to be testifying here today since it was the brainchild of the former Chairman of this committee, the late George Brown. Chairman Brown was an articulate advocate for international science and engineering research collaboration, and he understood the value that that collaboration had as a tool to advance U.S. foreign policy and national security.

In the early '90s when the Soviet Union was disintegrating, and engineers and scientists in the former Soviet Union's weapons laboratories were not being paid, there was a deep concern that those scientists and engineers would offer their services to governments that do not have the best interest of the United States at heart. Chairman Brown's first charge to CRDF was to fund these scientists and engineers to convert themselves to civilian research. I am glad to report that that particular mission has mostly been accomplished. Chairman Brown's truly clever scheme not only kept the weapons designers at home but helped enhance their civilian research capacity in contributing to the increased stability and prosperity of Russia and other members of the former Soviet Union.

The success of the original CRDF mission underscored Chairman Brown's broader vision and what a lot of us believe deeply, namely that science and engineering can be a powerful tool for fostering better international relations, but there is much, much more to do.

International collaboration of science and engineering is a two-fer. Number one, it solves important human problems and thus contributes directly to security, prosperity, and health. But number two, it also creates those personal relationships and trust that engender peace. Based on that philosophy and our experience in Russia, the mission of CRDF is the promotion of peace and prosperity through international science and engineering collaboration.

Scientists and engineers I believe are an extremely valuable but underutilized resource for U.S. foreign policy. As Mike just mentioned, according to numerous polls, the single-most admired aspect of the West among Muslims is our technology prowess. We can and we should exploit that admiration.

CRDF is a unique organization. It is an independent 501(c)(3) not-for-profit corporation, but it was created by the U.S. Congress to advance U.S. foreign affairs and national security. We think of CRDF as a "do-tank," as opposed to a "think-tank." We are implementers of things. We implement good ideas to encourage collabo-

ration between U.S. and foreign scientists and engineers. Our unique specialty is to quickly and efficiently implement international science and technology collaborations based on merit and implement it with transparency, flexibility, and accountability.

The success of the original charge from Chairman Brown also underscored that just giving out research grants wasn't enough. There is a whole infrastructure that supports research and increases the probability of collaboration opportunities for U.S. scientists. That infrastructure includes things like peer review for merit-based awards, the ability to write proposals, grant administration, logistics for joint research, and on and on. Those are all things that we take for granted in the U.S. research system but in fact are not present in many foreign systems.

So CRDF had to create that infrastructure, and so now CRDF's activities fall into about 20 programs, certainly support for research collaborations. This fall we will be announcing a competition for research on climate change. We also carry out nonproliferation activities, sort of the original mission from Chairman Brown. For example, we have recently managed to change what was a bioweapons laboratory in Siberia into one that is monitoring for avian flu.

New program support, for example, logistical support for joint research between ourselves and the Russians in the Arctic. We do training on things like bioethics, on how to do peer review, on research management, and grant administration.

We have a number of activities related to institution building. For example, in most parts of the world, basic research is not done in universities as it is in the United States. We happen to believe that supporting basic research in universities is both good for the research and good for the universities, and so we have undertaken activities, particularly in Russia, to encourage that activity. We, as CRDF, did that at 20 universities. The Russians were so enamored and appreciative of that, they have done it by themselves in 15 additional ones. We are also focused on innovation and knowledge transfer. We have a program called Next Steps. We have created technology transfer offices in a number of universities.

As an independent, non-profit, non-governmental organization, CRDF has capabilities that complement those of government agencies such as NSF. For example, CRDF can move quickly and flexibly to respond to opportunities that arise. It can fund foreign research scientists and engineers to collaborate with their U.S. counterparts. It can seek and negotiate cost-sharing programs with foreign governments and multi-nationals. It offers potential overseas partners a U.S. entity that is not part of the U.S. Government, a property that is especially important in those countries that are suspicious of the intent of the U.S. Government.

Examples of all of these are given in the written version of my testimony, but as just one example CRDF has secured $43 million in cost sharing from foreign governments on 675 projects in 10 different countries.

Recognizing the value of these complementary capabilities, CRDF has been tasked by a number of U.S. Government agencies including the Department of State, NSF, DOD, the Department of Energy, and the National Institutes of Health. Again, examples of

the kinds of tasks we do for them are in my written testimony, but for example, the Department of State has been our principal funder of original work in Russia and the former Soviet Union. CRDF also stays in close touch with other NGOs such as those here today, but especially the National Academy of Sciences and the AAAS. We each have unique strengths to contribute, so by working together, we maximize the quality of our international activities.

In summary, I would emphasize four points in my testimony. Number one, science and engineering diplomacy can be a powerful tool for communication with influential citizens of countries that have limited or strained relations with the United States. Second, scientists and engineers share a set of values that transcend culture. Those shared values facilitate developing the trust that is essential to achieving U.S. foreign policy and national security objectives. Third, science and engineering NGOs such as those here today provide complementary capabilities to those of the U.S. Government to further effectiveness of science and engineering diplomacy. Finally, CRDF's special contribution is as a "do-tank," that is, an implementer of science and engineering diplomacy activities and programs. We do whatever it takes to make those programs effective. Thank you.

[The prepared statement of Dr. Wulf follows:]

PREPARED STATEMENT OF WILLIAM A. WULF

Introduction

Chairman Baird, Ranking Member Ehlers, and distinguished Members of the Subcommittee, thank you for this opportunity to discuss the role of non-governmental organizations and universities in international science and technology collaboration. I commend the leadership of this committee for developing these hearings to highlight the importance of engaging some of our most valued resources in the United States, our scientists and engineers, to help lead the world toward global solutions for global challenges to build peace and prosperity for all. The United States—government, non-governmental organizations and universities—must do more to engage our scientists and engineers in international collaboration.

I have had the privilege of testifying before this committee on a number of occasions, including when I served as President of the National Academy of Engineering. It is a great pleasure to return today as a member of the Board of the Directors of the U.S. Civilian Research & Development Foundation (CRDF) and to share with you the experience that CRDF has accumulated over twelve years. During that time, CRDF has developed a world-class reputation as an effective and efficient implementer of global science and technology collaborations and a solid partner with the U.S. Government, private sector, and foreign governments and institutions. CRDF's programs have had direct benefits to American science objectives, but also to U.S. foreign policy, public diplomacy, national security, and competitiveness.

It is highly fitting that CRDF is testifying before the House Science Committee. It was this committee, under the leadership of your former Chairman the late Congressman George Brown, that spawned the creation of CRDF in 1992. As you know, Chairman Brown was an ardent and articulate advocate of developing innovative efforts to build science and technology collaboration between the U.S. and other countries. He understood the benefits to the U.S. scientific community of high-quality international collaborations in the basic and applied sciences. He understood the value of international science and technology cooperation as an important tool to advance U.S. foreign policy and national security, specifically at that time with the countries of the former Soviet Union (FSU). Finally, he felt strongly about the role of NGOs in helping to build these partnerships, thus the establishment of CRDF. It is for this reason that CRDF gives an eponymous annual award for international science achievement—the George Brown Award for International Scientific Cooperation.

CRDF: HISTORY, MISSION, AND PROGRAM ACCOMPLISHMENTS

CRDF is a unique organization in that it is an independent, non-governmental organization created by the U.S. Congress to help advance U.S. science, foreign affairs and national security priorities. Based in Arlington, Va., with three support offices abroad, CRDF has grown to include a global staff of over 130 people working with more than 20 countries. Incorporated as a not-for-profit organization in the Commonwealth of Virginia, CRDF is governed by an independent Board of Directors whose fourteen members represent a cross section of American science, foreign policy, nonproliferation, academic and business communities. CRDF also routinely seeks advice from a group of preeminent experts, including a Nobel laureate in chemistry, who serve on CRDF's Advisory Council. CRDF's staff contributes experience in science, international affairs, program and project management, finance, grant administration, nonproliferation and policy-making. Many of our staff have lived, studied or worked overseas. The scientific backgrounds of many of our foreign staff and their experience working in the science establishments of their own countries provide invaluable capabilities and credibility for successful implementation of CRDF's program activities.

CRDF's unique specialty is its ability to quickly and effectively implement international science and technology partnerships selected on scientific merit and mutual benefit, and executed with transparency, flexibility, and accountability. It partners and works closely with scientists and policy-makers in the U.S. Government, other NGOs, universities, foundations, and U.S. companies, as well as with key foreign governments and partners, successfully supporting international collaborative projects valued at over $350 million. These projects include more than 3,000 grants that CRDF has made under its own programs, and over 1,200 separate projects that CRDF has administered on behalf of U.S. Government agencies, universities and businesses supporting research and development projects overseas.

For its own programs, CRDF is extremely effective at leveraging the funds it receives with contributions from other sources, and has secured $43 million in cost-sharing, primarily from foreign government agencies, for 675 projects in ten countries. For example, under its Basic Research in Higher Education (BRHE) program in Russia, CRDF has obtained cost-sharing from Russian sources, including the Russian Federation Ministry of Education and Science, regional and local sources, and universities. These sources contributed 50 percent of the initial core grants, and then have increased their share, such that they now provide 70 percent of all program costs and by 2010, they will have assumed 100 percent of the program costs.

CRDF also works hard to advance the goal of science for diplomacy working in partnership with top scientific societies such as our colleagues here—AAAS and the NAS—as well as with other organizations to focus on how best to help policy-makers better understand the unique resources of the U.S. scientific community in fostering and advancing U.S. foreign and national security priorities. Finally, given our success working with the countries of the former Soviet Union, CRDF has expanded its geographic focus across Eurasia, and into the Middle East, North Africa, and Asia. The model and methods developed with this experience can be successfully applied to many situations.

History

Sixteen years ago, Science Committee Chairman Brown, on the Floor of the House of Representatives, introduced the *"AmeRus Foundation for Research and Development Act"* and explained that this bill would "establish an independent, endowed foundation which will identify and fund cooperative research and development ventures between engineers and scientists working in industry, academia, and defense in the United States and the former Soviet Union." In October 1992, Congress passed the *FREEDOM Support Act of 1992.* Section 511 of that bill authorized the creation of the foundation. Three years later, the U.S. Civilian Research & Development Foundation was established, with initial funding from the Department of Defense through the Nunn-Lugar program and the National Science Foundation, to advance U.S. policy and security interests through international science collaboration.

Congressman Brown's support for CRDF was bold. It came at a time of significant geopolitical change overseas and an economic downturn at home. The break-up of the Soviet empire, and the consequent need to secure the weapons of mass destruction and ensure economic stability in the successor states, dominated the U.S. foreign policy agenda. Congressman Brown recognized an historic opportunity for the United States to foster economic stability through support of science and technology cooperation. He argued that the scientists and engineers in the newly independent states would ". . . play a key role in determining whether the transition to an open and market-driven society will succeed . . ."

Arguing for support of foreign scientists and engineers during a period of economic downturn in the United States was not easy. Congressman Brown acknowledged the competing demands for budgetary resources and argued that the only "rationale approach" for this new foundation would be based on "mutual cooperation, collaboration and benefit." The underlying model involved partnerships between scientists and engineers in the former Soviet Union and scientists and engineers in the United States. In other words, scientists and engineers from the United States would be directly involved in the cooperation and stand to benefit from the research, which would be selected based on merit and mutual benefit. The challenges and vision Congressman Brown articulated in 1992 in the former Soviet Union are as relevant today. They also are transportable to other countries and regions facing significant challenges that would benefit from more proactive international scientific engagement programs and initiatives.

CRDF Mission

Today, CRDF remains rooted in the basic principles and approaches outlined by the Science Committee sixteen years ago. CRDF has taken its successful track record in the FSU to implement its mission in other countries and regions globally. The CRDF mission is to:

- Provide cooperative research and development (R&D) opportunities that enable scientists and engineers to address critical security, economic, education and other societal needs worldwide.
- Advance peace and prosperity by funding civilian research and development projects that contribute to global nonproliferation objectives.
- Promote the application of science and technology to economic growth through international partnerships and training that foster invention, innovation, entrepreneurship and the commercialization of technology.
- Strengthen university research and education in science and engineering.

Program Components and Accomplishments

CRDF realizes its mission by designing and implementing a range of program activities that jointly meet donor requirements and respond to the needs in each country. CRDF currently is administering over *twenty programs* that address each of the four mission areas, as follows:

Research Collaborations

CRDF supports and funds high-quality collaborative research and development projects in the natural sciences. Research projects involving U.S. scientists and foreign counterparts are selected through merit-based competitions. CRDF has provided nearly 1,500 grants in support of collaborative research projects valued at more than $78 million and involving approximately 8,000 scientists in 15 countries. Targeted research competitions have also been designed to address specific areas of priority to funders, including general biomedical research, HIV/AIDS research, antiterrorism research, and this coming year, global climate change.

CRDF's flagship research collaboration program is the Cooperative Grants Program (CGP). This program provides up to two years of support for joint U.S. and foreign research teams in all areas of basic and applied research in the natural sciences. Such collaborations strengthen the quality of foreign research to collaborate more effectively with U.S. and international partners, provide opportunities for junior researchers and female scientists, support the redirection of former weapons scientists to civilian research, and establish the background of knowledge and technology on which successful industry and business partnerships with U.S. institutions may be built. Historically, cooperative research grants have averaged about $60,000 each but amounts can vary by the research program and the local context in which the awards are made. Grants to the foreign teams typically include individual financial support; equipment, supplies and travel support; and institutional support to the grantee institution; U.S. team expenses are generally confined to travel, supplies, and graduate student stipends.

Such cooperative research grants are extremely valuable in addressing global challenges that can benefit greatly from S&T solutions. One example, focused on disaster mitigation and earthquake hazard, is a CRDF grant to the Institute of Vulcanology and Seismology in Kamchatka, Russia, and Pennsylvania State University. This team improved the scientific understanding of the generation, transport, and deposition of dangerous explosive volcanic gravity flows of hot ash-gas mixtures. Using numeric modeling to simulate directed blast clouds of volcanic eruptions and

validating the computer results against field and lab data has resulted in findings that are invaluable for volcanic hazard assessment worldwide.

Another successful CRDF grant, focused on biodiversity and agriculture, involves the Ketshkoveli Institute of Botany in Tbilisi, Georgia, and the Missouri Botanical Garden who jointly established the first Caucasus Regional Seed Bank in Tbilisi. The seed bank is a living reservoir of biodiversity in the Southern Caucasus, one of the United Nation's designated world biodiversity hot spots. The seed bank includes many wild varieties of crops originally domesticated in the Caucasus, and examples of plants used as folk remedies, which are candidates for clinical study and use as effective medicines. Some species have already been successfully reintroduced into the wild. CRDF has literally dozens of such cases where joint research has yielded important findings, led to improved partnerships, or opened new areas for investigation.

Nonproliferation and Security

Since its inception, CRDF has worked to transition former weapons of mass destruction (WMD) scientists to civilian research. CRDF has been able to engage former weapons researchers in productive civilian R&D, converting former related facilities to civilian use, and upgrading security at civilian facilities to prevent their misuse. Given CRDF's expertise and credibility in helping to transition former weapon researchers, the Department of State and Department of Defense continue to request CRDF's help in implementing a variety of threat reduction programs. Most are focused on biological weapons research and conversion of scientists and their associated facilities to civilian applications.

For example, CRDF formed a collaborative project with *Vector,* a former biological defense research facility in Siberia. Highly trained American and Russian virologists collaborated to establish this critical effort to monitor migratory birds as they flew over Novosibirsk, in Siberia. American scientists now famous for their work on avian influenza provided the reagents to *Vector* that allowed the typing within 24 hours of the H5N1 outbreak. Today, the World Health Organization (WHO) is tapping into the capacity that CRDF built at *Vector* and specialists are considering this a model disease surveillance program for emerging threats.

This Russian flu surveillance project is an example of the type of contribution CRDF is offering to the U.S. State Department. A recent focus has been support for the State Department's Biosecurity Engagement Program (BEP), which reduces the risk of biological threats by collaborating with partner governments to develop biosafety and pathogen security standards that are consistent with national and international guidelines, norms and requirements. What is more, CRDF has demonstrated our ability to rapidly respond in difficult environments and transition scientists into meaningful civilian alternatives.

CRDF also recently completed a contract with the Defense Threat Reduction Agency (DTRA), where CRDF managed three Cooperative Biological Research (CBR) projects that engaged scientists from Uzbekistan and Kazakhstan in research that resulted in 19 abstracts presented at international conferences and two articles in peer-reviewed journals. The projects helped to build institutional research capacity; improve biosafety and biosecurity, and increase knowledge of local pathogens. Here is another example of how engagement of this kind brings these people and organizations into the broader international community with strong linkages to U.S. policy and practice.

Innovation and the Transition to Knowledge Economies

CRDF has supported a suite of programs to link foreign researchers and entrepreneurs with prospective U.S. industry partners or investors. CRDF introduced a pioneering industrial R&D collaborative program that matched CRDF's funding of $11 million with $13 million in funding from U.S. partner companies, such as 3M and General Electric. CRDF's "Next Steps to Market" program resulted in four new companies and six commercial partnerships with commercial sales throughout Eurasia and the United States.

As an example, a small U.S. small business based in California, SciClone Pharmaceuticals, working on compounds that address tuberculosis (TB), received funding from CRDF to work with *Verta,* a St. Petersburg, Russia-based institute. *Verta*'s researchers had an alternative TB treatment compound that could be taken orally—a more globally viable delivery method. Notably, this collaboration provided the two dozen former biological-weapons scientists employed by *Verta* with an opportunity to transition their weapons expertise. The partnership has brought the world closer to a new TB treatment much more quickly than either SciClone or *Verta* could have done alone, while helping to advance U.S. small business.

More recently, CRDF organized Eurasian Innovation and Investment Fora in Cleveland, Ohio and Fairfax, Virginia, to bring together promising Eurasian high technology entrepreneurs with potential U.S. partners in fields such as alternative energy and information technology. One of the participants in the Northern Virginia Forum was a Russian technology company, *Gravitonus,* which subsequently established a presence in the U.S. for its cutting-edge technology that helps persons with disabilities to use personal computers effectively. Company president and founder Dr. Alex Kosik, a spinal cord surgeon in Russia, wanted to persuade potential American investors to help him produce the Alternative Computer Control System (ACCS)—a special assistance device that is placed in a person's mouth and controlled by the tongue and biting action. Through partnership with CRDF and the Mason Enterprise Center at George Mason University, *Gravitonus* is now able to set up volume production, distribution, sales and marketing operations and customer support services in the United States. "CRDF has given us a great opportunity," says Kosik. "We feel that our R&D efforts are noticed. We see that CRDF cares. And it really helps us and inspires us to move forward." Such commercial bridge building accelerates the adoption of beneficial technologies in the U.S., creates employment, and ultimately, may contribute to export sales from the U.S. as such products are developed and perfected.

Building New S&T Institutions

CRDF provides institutional support for scientific research centers, universities and grant-making organizations in order to promote scientific research and to nurture capacity overseas to allocate R&D resources on the basis of merit review. CRDF has established and funded *fifty* such institutions in nine countries throughout Eurasia, stretching from the Black Sea to the Sea of Okhotsk on the Pacific Rim. Four of these organizations—in Armenia, Azerbaijan, Georgia and Moldova—help their respective nations gain experience in allocating scarce R&D resources based on merit-based competitions. Modeled on the U.S. National Science Foundation, these grant-making organizations help to build the necessary capacity for long-term development of science and for international collaboration. They also promote democratic values such as open competition through a transparent process employing the principle of merit review.

CRDF has also provided major state-of-the-art equipment and training to 21 competitively selected institutes across eight countries in Eurasia (Armenia, Azerbaijan, Georgia, Kazakhstan, Moldova, Russia, Ukraine, and Uzbekistan). These shared-use centers are utilized by nonprofit research and education institutions as well as the industrial research communities within the regions where the equipment is located. CRDF committed $6.5 million towards equipment and supplementary grants. Eurasian governments and local institutions have provided additional support of roughly $1 million to this program.

Advancing Research Capacity in Higher Education

With funding from the U.S. private sector and Russia, CRDF developed a unique partnership with Russia to introduce a new model for integrating research and education in Russian universities. Since 1998, the Basic Research and Higher Education (BRHE) program has established 20 Research and Education Centers at Russian universities to strengthen the university research infrastructure, develop new curriculum, engage students in research early in their careers, improve external linkages and foster the commercialization of technology. In 2005, the Russian Ministry of Education and Science validated the BRHE model when it independently established 15 new centers patterned after the BRHE program. In 2008, independent evaluators called BRHE "the Right Program, at the Right Time and with the Right Process." This model has recently been duplicated in five other countries, each of which has contributed substantial cost-share funding to their joint programs with CRDF.

Specialized Programs

Over the years CRDF has designed and implemented numerous specialized and general training programs to address a wide range of global needs, including training in bioethics, peer review and scientific proposal writing, English language for scientists, research management, and grant administration. CRDF has also employed information and communications technologies to facilitate these programs. For example, in August 2007 CRDF conducted training for the seven original participating institutions of the Iraqi Virtual Science Library. CRDF serves as the Secretariat for this program, which allows Iraqi academic faculty and students to access

current scientific literature. Following the training, the number of registered users grew by more than 200 new users per month and continues to expand.

Program Support Services

CRDF places a high priority on accountability and transparency in implementing and managing its grants. CRDF has a dedicated department that focuses solely on the effective administration of all aspects of award management. The department oversees CRDF's network of international banking agreements, in-country support contractors, and international travel agencies and equipment vendors. The department also oversees all compliance and legal issues associated with project implementation from export controls to bioethics to taxation to intellectual property. Extensive payment distribution systems provide for the efficient and transparent disbursement of project funds and equipment to grantees from $100 payments to individual students working on projects to multi-million dollar equipment purchases. In addition, the department oversees CRDF's project audit functions and conducts regular site visits and audits to ensure the highest level of assurance that resources are directed to their intended recipients and effectively utilized for the intended result.

The systems developed for the management of CRDF's international grants have proven very effective and, as a result, CRDF utilizes these mechanisms to support almost 200 U.S. Government, university, for-profit company and NGO organizations in the financial and administrative management of their own international projects and activities. A list of customers under GAP Services is attached at Appendix A.

ROLE OF CRDF AS AN NGO AND COORDINATION WITH THE U.S. GOVERNMENT

The Congressional sponsors of CRDF believed strongly in the potential contribution of a non-governmental mission to international science and technology cooperation. They cited the successful precedents of the three non-governmental foundations that the United States and Israel established in the mid-1970: the Binational Industrial Research and Development (BIRD) Foundation; the Binational Agricultural Research and Development (BARD) Foundation; and the Binational Science Foundation (BSF). They were aware of previous efforts in the late 1970s to develop a major NGO to advance global scientific collaboration to advance development that was never realized. Finally they understood that there are times when an independent NGO—working in partnership with the U.S. Government—can help implement programs more effectively. Over the years as CRDF's reputation has grown, it has received more calls for help from the U.S. Government. Its strengths—as well as its limitations—as an NGO are listed below:

Strengths as an NGO

As an NGO, CRDF has been able to operate quickly and flexibly in responding to emerging opportunities. For example, just a month after the events of 9/11, CRDF launched an initiative to engage U.S. and Eurasian scientists in collaborative research to reduce the effects of terrorist acts on civilian populations. CRDF supported a series of 11 workshops where hundreds of scientists gathered to focus on research to detect, protect, and treat in the case of a terrorist event. Some $1.5 million was committed to follow on grants to these teams of scientists, with funding from several U.S. government agencies.

In 2004, while the U.S. Government was developing plans for science initiatives with Iraq, CRDF organized an orientation visit to Washington, DC, for a group of six Iraqi scientists. CRDF introduced them to scientists in U.S. Government agencies, local universities and businesses. Many of those scientists have subsequently participated in research projects with U.S. counterparts.

As an NGO, *CRDF can seek and negotiate cost-shared programs with foreign counterparts.* As mentioned earlier, CRDF has secured $43 million, primarily from foreign government agencies, for 675 projects in ten countries. These cost-shares expand the scope and impact of CRDF programs in-country and set the stage to transition from cost-sharing to exclusive host-country funding.

CRDF is able to leverage resources of multiple organizations as well. For example, CRDF's Cooperative Grants Program leverages funding from the State Department, National Science Foundation and National Institutes of Health, to support collaborative research projects between U.S. scientists and their counterparts in Eurasia. CRDF's premier university initiative, the Basic Research and Higher Education Program, leverages funding from the John D. and Catherine T. MacArthur Foundation, the Carnegie Corporation of New York, the Russian Ministry of Education and

Science and regional governments in Russia to support twenty Research and Education Centers at Russian universities.

Another strength of CRDF is its ability to quickly engage specialized expertise for program design and implementation. CRDF has developed a network of more than 40,000 scientists and engineers who conduct merit review of proposals submitted to CRDF; participate in review panels or site visit teams; advise CRDF on program design and implementation; and provide specialized expertise. CRDF works closely with key U.S. science and engineering organizations and societies to ensure that we tap the best expertise for existing or new programs. We have also partnered with the Arab Science and Technology Foundation in the United Arab Emirates (UAE) on workshops and other programs to promote science collaboration between U.S. and Arab scientists. CRDF has formed partnerships with the King Abdullah University of Science and Technology (KAUST) and the Qatar National Research Foundation (QNRF) to provide CRDF's expertise in implementing science and technology cooperative programs, building organizational capacity in information technology, database administration, peer review and grant administration support.

As an NGO with on-the-ground support offices in Russia, Ukraine, Kazakhstan, and soon in Azerbaijan, CRDF has the staff expertise and resources to offer flexible solutions to meet customer needs. For example, our Russian office staff has provided support to the National Science Foundation's Arctic programs division in the implementation of their programs with the Russian Federation, working with Russian government agencies and research institutes to coordinate work in the Arctic region. Through our GAP program, CRDF has assisted over 200 organizations who work in the FSU to implement more than 1,200 projects by providing flexible and accountable project management services.

As an NGO, CRDF offers potential partners overseas a U.S. counterpart that is not part of the U.S. Government. Because CRDF is a non-governmental, non-profit organization, it is often seen as a neutral partner in developing program initiatives between the US and its foreign counterparts. CRDF has been able to fulfill this role while maintaining U.S. policy objectives. Moreover, CRDF can invest the time and resources needed to build the relationships and trust that are so necessary to engaging foreign scientific communities in new programs of cooperation with the United States.

As an NGO, CRDF's mission is broad. This breadth enables CRDF to offer a wide range of program implementation strategies for multiple customers. As of July 1, 2008, CRDF is implementing over 20 programs for more than thirteen sponsors and customers. In addition, our GAP program currently is implementing 350 projects for over 100 customers. Other organizations, including U.S. Government agencies and non-governmental entities, are supporting activities related to one or more of CRDF mission objectives. However, CRDF is unique in its combination of mission objectives and capability to implement across a wide range of issues and countries.

Limitations as an NGO

While CRDF has achieved remarkable success in its twelve years of operation, its forward progress is constrained by the absence of multi-year funding. CRDF was originally envisaged as an endowed foundation that would operate similar to the foundations that the U.S. established with Israel. That endowment did not materialize, and hence, CRDF must constantly seek new funding for all of its program activities and to maintain its core staff capabilities. In almost all cases, that funding is secured on an annual basis, which limits the ability of CRDF to develop long-term program strategies with partners overseas. CRDF also needs to retain some flexibility in designing its programs as needs on the ground can evolve over time and out-pace the ability of governmental agencies to respond in a timely way.

Coordination with the USG

CRDF coordinates its work closely with the United States Government, which has been the primary source of funds for CRDF program activities. For example, in 2007 federal expenditures accounted for over $18 million, out of almost $25 million, in CRDF activities. The federal expenditures include funds from the Departments of State, Defense, and Energy, the National Science Foundation and the National Institutes of Health. Overall, the largest single source of funds has been the State Department's *FREEDOM Support Act* funds, which have declined from a high of $15 million in 2002 to $5.7 million in fiscal year 2007, with further reductions expected in fiscal year 2008.

As CRDF's primary funder, the Department of State continues to request CRDF help in implementing its programs. CRDF works closely with a number of the Department's geographic and functional bureaus to advance international science col-

laborations on behalf of the Department. However, the significant decrease in FSA funding has significantly impacted the type of programming and impact that CRDF can exert. The decline in FSA funding reduces CRDF's ability to respond quickly to new opportunities in priority countries and to take advantage of cost-sharing offers from foreign partners. CRDF has annually been included in the House and Senate foreign operations appropriations report, and in recent years the Congress has urged the Department of State to expand funding for CRDF from other accounts beyond the FSA.

CRDF works with a number of other U.S. Government agencies, helping them advance their global research interests. For example, with funding from NSF supplemented by other agencies, CRDF has supported over 1,000 collaborative research projects between U.S. scientists and counterparts in Eurasia and Eastern Europe. The projects cover multiple disciplines, such as biology, chemistry, physics, engineering, math, IT, and geology and are selected based on merit review. Additionally, on behalf of NSF, CRDF manages a small number of bilateral programs primarily in Russia and Eurasia which include Arctic area research, fellowship and exchange programs, and support for international conferences in various scientific disciplines. NSF-funded CRDF programs have benefited from annual cost-sharing from the governments of Russia and Ukraine.

With funding from NIH, CRDF has engaged scientists around world in cooperative research projects with U.S. partners to investigate high-priority topics in global health, including: disease prevention, treatment, and surveillance; innovative cancer diagnostic methods; and new approaches to HIV/AIDS, tuberculosis, and hepatitis C. In particular, CRDF manages several international programs in public health, primarily in infectious disease prevention and monitoring, centers of excellence for public health education, and in research on HIV/AIDS. CRDF's support for HIV/AIDS research entered a new phase in 2008 with the HIV/AIDS Research Public Health Centers of Excellence program. This program, jointly funded by the Russian Ministry of Education and Science, funds two U.S.–Russian interdisciplinary consortia to apply international best practices to HIV/AIDS research in Russia. The centers are focusing on pressing research needs in Russia, TB co-infection and behavioral factors in HIV transmission, and providing a model for future interdisciplinary public health research centers in HIV and other global health threats, such as tuberculosis, heart disease, and substance abuse.

For the Department of Energy, CRDF has provided logistical and financial support for a number of engagement programs between DOE and its international counterparts, primarily in Russia. Finally, for DOD through the Defense Threat Reduction Agency (DTRA), CRDF has managed science engagement programs with a number of institutes in Eurasian countries that have had biological weapons capabilities or histories, supervising their transition to civilian applications, research, and commercialization.

CRDF routinely submits proposals for work to U.S. Government agencies and if selected, operate under a federal grant or contract. CRDF complies with all applicable rules and regulations as a grantee/contractor and reports regularly to the sponsoring agency on the progress of the work. CRDF maintains regular contact with the policy-making community and Congress to keep them updated on the progress of CRDF work and new opportunities that may be of interest to government sponsors.

THE FUTURE: HOW CAN THE USG WORK WITH NGOS AND THE U.S. SCIENTIFIC COMMUNITY TO PURSUE FOREIGN POLICY GOALS AND GLOBAL CHALLENGES?

The Time is Right

Never has CRDF's vision, "international peace and prosperity through international science collaboration," been more relevant than it is today. The U.S. science and technology enterprise is the best in the world. U.S. leadership in science and technology is recognized globally. According to the Gallup World Poll conducted over six years and which covers 40 majority Muslim countries and 90 percent of the global Muslim population, the single most admired aspect of the West among Muslims around the world is technology. When asked what the West can do to improve relations with the Muslim world, the most frequent response after the resounding call for the West to respect Islam, is for the Western nations to help Muslim countries with capacity building and technology transfer.[1]

[1] Statement by Dalia Mogahed, Senior Analyst at Gallup and Executive Director of the Gallup Center for Muslim Studies; author of the book *"Who Speaks for Islam?: What a Billion Muslims Really Think"* (Gallup Press, March 2008).

American scientists and engineers represent an incredibly valuable, but underutilized, resource in U.S. foreign policy. With adequate support and incentives, U.S. scientists and engineers can reach out to societies around the world and apply "smart power" through international science and technology cooperation. Secretary of Defense Robert Gates and others have argued for more effective use of U.S. "smart power" to invest "in the global good—providing services and policies that people and governments want but cannot attain in the absence of American leadership."[2] We need to engage our leaders to utilize our scientists and engineers to reach out to counterparts around the world and engage in long-term science and technology projects that find collaborative solutions to common problems in health, environment, energy and agriculture.

Today's most vexing problems are global in nature and are not limited to the geographic boundaries of any one country. So, too, the capability to solve technical problems resides around the world. The best approach to solving global problems is to involve global teams of scientists and engineers. By contributing to the solution of these problems, the U.S. engenders gratitude and trust. By collaborating in their solution, the U.S. builds capacity and hence leverages our efforts. Scientists and engineers tend to share values that transcend cultures, thus facilitating more rapid trust relations. This is very important as a diplomatic tool—to reach out to global partners in ways that diplomats cannot. In many developing countries, the technical leadership is tied into the political leadership more so than in developed countries. This too can be an important avenue to encourage sound political decision-making.

The U.S. Government's Role

The U.S. Government must significantly expand its support for international science and technology cooperation. It should begin by articulating a clear policy statement endorsing international cooperation as a key component of U.S. foreign policy and assistance, national and economic security, and a priority for U.S. research and development agencies. The White House should increase attention to international science and technology cooperation and reestablish a high-level, interagency committee to coordinate U.S. Government efforts.

The U.S. Government should promote an environment that is conducive to international science and technology by routinely reviewing policies and procedures that affect the implementation of international science and technology cooperation. The appropriate U.S. Government agencies should work to reduce barriers to cooperation, such as the difficulty of obtaining visas.

The U.S. Government should increase the resources allocated to international science collaboration. For example, international program offices at federal R&D agencies should be allocated additional resources to explore and expand international cooperation. Seed funding should be made available for "start-up" activities under the intergovernmental science and technology agreements that the U.S. signs with foreign counterparts. These agreements are often signed with great fanfare but do not live up to expectations, particularly for our foreign counterparts, because there generally is no funding to pursue concrete activities. U.S. foreign assistance programs should increase their attention to science and technology for capacity building overseas.

The U.S. Government should increase its partnerships with non-governmental organizations to initiate and implement international science and technology cooperation. NGOs offer the speed, flexibility and responsiveness needed to pursue new opportunities and to execute constantly evolving policy and programmatic priorities of U.S. Government agencies. NGOs have the ability to get "on-the-ground" quickly and develop the relationships and trust needed to initiate new partnerships, often in difficult circumstances. At the same time, NGOs are able to work with transparency, openness and accountability overseas, and to foster the same in our partners.

Catalyzing a New Global Initiative

Most importantly, the U.S. Government should launch a strategic, new global initiative to catalyze, broker, amplify and scale up science and technology cooperation for the benefit of the United States and its partners around the world. This new initiative should be a global public-private partnership with the U.S. taking the lead

[2] Center for Strategic and International Studies (CSIS), *"Implementing Smart Power: Setting an Agenda for National Security Reform,"* a statement by Richard L. Armitage, President, Armitage International, and Dr. Joseph S. Nye, Jr., Distinguished Service Professor, Kennedy School of Government, Harvard University, before the Senate Foreign Relations Committee, April 24, 2008.

in challenging other governments and private donors to match the U.S. contribution. Patterned after other public-private partnerships, such as the Global Fund to Fight AIDS, Tuberculosis and Malaria, this new global science initiative would engage scientists internationally to encourage critical scientific and technical advances that address global challenges including infectious disease, food security, energy alternatives and vanishing ecosystems; to reach young scientists and support a robust research and educational infrastructure; and to build mutually beneficial economic partnerships. It would facilitate greatly expanded international science and technology cooperation as well as enhance institutional capacity in the developing world. Nations with a strong, stable science and technology base are better participants in the global economy, develop indigenous solutions to national problems, and contribute to ongoing international collaborative efforts.

CRDF as a Global Partner for the Future

With over a decade of strong support from both public and private donors, CRDF has developed a potent and unique capability to implement international science and technology cooperation. CRDF's many successes validate the vision that the leadership of this Science Committee articulated in 1992. CRDF has demonstrated that Congressman Brown was right when he argued for the creation of a non-governmental organization to help achieve U.S. foreign and national security policy objectives through international science and technology cooperation that benefits both the United States and its partners overseas.

The global environment in which CRDF operates has changed dramatically since CRDF began in 1992. New opportunities to collaborate in science and technology are emerging rapidly as countries focus attention on building knowledge-based societies. The demand for science-based solutions to complex global challenges in health, energy, agriculture, economic well-being and security is high. Meeting such challenges requires international science and technology collaboration that brings together the best minds and innovative approaches to find mutually beneficial solutions. It is in the U.S. interest to encourage such collaboration. CRDF also sees many opportunities to continue its record of success in other regions where science cooperation can make a positive contribution to U.S. policy, especially in the Middle East and in South Asia.

CRDF will continue to work in partnership with the U.S. Government, foreign partners and other NGOs to develop international science and technology cooperation that builds on CRDF proven models and addresses high priority opportunities or needs. For example, through its higher education and research initiative, CRDF will work to establish and integrate scientific research more effectively into university programs overseas and to develop opportunities to engage foreign students and young researchers—the next generation of scientists—into productive, long-lasting collaborations with the U.S. partners.

CRDF will continue to develop program initiatives to engage scientists and engineers in the Middle East and other Muslim countries in collaborations that generate new knowledge, apply research to address priority needs in health, agriculture, water and energy; and build capacity for education, research and economic development through science and technology. A high priority will be collaborative research programs that encourage U.S. scientists to identify and partner with foreign scientists on mutually beneficial, competitively selected projects. Together, these joint research teams can address common problems while developing long-lasting relationships of trust and collaboration.

CRDF will continue to work with new science and technology institutions overseas to develop mechanisms and procedures that promote merit-based selection of projects and opportunities for collaboration with U.S. scientists. Building on its successful experience managing the Iraqi Virtual Science Library, CRDF will work with others to help bring this type of digital library resource to other countries. A number of countries have expressed a desire for CRDF's assistance to partner with them on creating and maintaining access to scientific literature, research databases, and other similar tools. These activities stimulate collaborative research, allow access by scientists to a wider community of scholars, and ultimately contribute to a more open flow of information. CRDF sees a major opportunity for positive public diplomacy in stimulating and funding such programs to broaden access to scientific knowledge and norms as practiced in the U.S. research community.

CRDF will continue to pursue collaborative approaches to address global energy issues. This fall, CRDF will begin a new initiative in climate change research. With cost-shares from CRDF's international partners, CRDF will support international teams researching ways to measure and reduce the impacts of this global problem from a variety of scientific disciplines, including biology, chemistry, physics, geology, and engineering. This builds upon CRDF's track record of supporting international

collaborative projects that have studied solar energy, improved the potential and marketability of fuel cells, and explored sustainable energy. U.S. industry partners on these projects have included Shell, ConocoPhillips and GE. As an example, CRDF supported researchers from Armenia and the California Department of Water Resources to evaluate the energy capacity and wood yield potential of fast-growing poplar trees as a promising source of power and as a remedy for some of Armenia's heavily deforested regions.

CRDF's work in addressing energy-related issues was noted by the Ranking Member of the Senate Energy and Natural Resources Committee, Senator Pete Domenici, in his remarks regarding CRDF's ten year anniversary: "The Civilian Research & Development Foundation has amassed a very solid record of helping the U.S. Government achieve its foreign and national security policy agendas. By using science collaborations to advance peace and sustainable prosperity, we can best address the complex energy challenges that we face globally by uniting the talents of all the world's brightest minds. CRDF is uniquely positioned to help enable these international collaborations that will benefit all of us in the energy field and elsewhere."

In conclusion, CRDF's unique expertise and track record have been tested with great success in the countries of the former Soviet Union. They are now being expanded slowly into other countries and regions. CRDF is working hard to help make the case for expanded partnerships to advance science for diplomacy and security. In partnership with AAAS, the NAS, Brookings, and others, CRDF is working hard to help raise awareness regarding science for diplomacy. We commend this committee for taking the lead here on Capitol Hill and we look forward to working with you and our partners here and in the government to make this dream that George Brown had a global reality.

APPENDIX A: CRDF GAP Services Customers

A service of the U.S. Civilian Research & Development Foundation (CRDF), GAP Services assists organizations seeking to engage the science, technology and engineering communities overseas. For ten years, GAP Services has helped companies work internationally by facilitating more than 1,000 individual projects, valued at over $190 million; and been a solution for more than 200 organizations, including 38 corporations of varying size and scope.

Business and Industry
3M
Advanced Thermal & Environmental Concepts, Inc
Altria
Aquila Technologies Group, Inc.
Biomedical Sciences Research Laboratories, Inc
Compaq Computer Corporation
Conoco, Inc.
Converting Systems, Inc
Corium International, Inc
Cortana Corporation
Curative Technologies Corporation
Diversa Corporation
Dupont Agricultural and Nutrition
Dupont International
Ener1, Inc
Glaxo Wellcome Experimental Research, SA
Huntsman Petrochemical Corporation
Hypres, Inc
Icon Genetics, Inc
Integrated Micro Sensors, Inc
Intel Corporation
Ionwerks, Inc
MagiQ Technologies
Manufacture Française des Penumatiques Michelin
Michelin Research Asia
Nuclear Fuel Industries
Optech International
Pathfinder Exploration LLC
Proteus, Inc
Samsung SDI Co, Ltd
Schlumberger Technology Corporation
ScintiTech, LLC
Shelly International Exploration and Production, B.V.
Syntroleum Corporation
Thorium Power, Inc

Educational Institutions
Baylor College of Medicine
Boston College
California Institute of Technology
Case Western Reserve University
Clemson University
Colby College
Colorado State University
Columbia University
Cornell University
Emory University
Hampton University
Howard University
Johns Hopkins University
Knox Grammar School (Australia)
Leiden University Medical Center (The Netherlands)
Massachusetts Institute of Technology
Medical College of Wisconsin, Center for AIDS Intervention Research
Medical University of South Carolina
Mount Sinai School of Medicine
New York University
Northwestern University
Politechnico di Bari (Italy)
Ravenswood School for Girls (Australia)
Tel Aviv University (Israel)
Texas A&M University
Texas Tech University
Thomas Jefferson University
Tufts University
University of Alabama, Birmingham
University of Alaska, Fairbanks
University of Arizona
University of California, Berkeley
University of California, Los Angeles
University of California, San Diego
University of California, San Francisco
University of Cincinnati
University of Connecticut Health Center
University of Delaware
University of Geneva (Switzerland)
University of Houston
University of Illinois, Urbana Champaign
University of Kentucky
University of Leicester (United Kingdom)
University of Massachusetts, Amherst
University of Minnesota
University of Montana
University of Nebraska
University of North Carolina, Chapel Hill
University of Oklahoma Health Sciences Center
University of Oregon
University of Pennsylvania
University of Pittsburgh
University of Queensland, Pyrometallurgy Research Centre (Australia)
University of Rochester
University of Texas, Austin
University of Washington
University of Wisconsin, Madison
Uppsala University, Svedberg Laboratory (Sweden)
Washington University
Yale University School of Medicine

Nongovernmental Organizations, Private Research Institutions & Professional Societies
Acoustical Society of America
American Geophysical Union
Armenian Research Council
Associated Universities, Inc./National Radio Astronomy Observatory
Bavarian Research Center for Knowledge-Based Systems (Germany)
Boston Medical Center
Bridgeport Hospital
Danish Space Research Institute (Denmark)
Dibner Institute for the History of Science and Technology
Fox Chase Cancer Center
Fred Hutchinson Cancer Research Center
Home-Start International
Howard Hughes Medical Institute
Human Frontier Science Program
Institut Francais du Petrole (France)
International Consortium for Research on the Health Effects of Radiation
International Union of Geodesy and Geophysics Commission on Geophysical Risk and Sustainability (Australia)
John D. and Catherine T. MacArthur Foundation
Joint Oceanographic Institutions
Juvenile Diabetes Research Foundation International
Ludwig Institute for Cancer Research (Switzerland)
Max Planck Institute for Physics (Germany)
Missouri Botanical Garden
National Academy of Sciences
NATO Science Programme (Belgium)
New York Community Trust
Paleontological Society
Research Foundation of the State University of New York
Research Triangle Institute
Roswell Park Cancer Center
Russian American Nuclear Security Advisory Council
San Diego State University Foundation
Spencer Foundation
Stanley Medical Research Institute
United States Industry Coalition
University of Georgia Research Foundation
Vital Spark Foundation
World Health Organization
World Wildlife Fund

U.S. Government Agencies
Defense Threat Reduction Agency
European Office of Aerospace Research and Development, Air Force Office of Scientific Research
NASA Kennedy Space Center
National Institute of Standards and Technology
National Oceanic and Atmospheric Administration
Alaska Fisheries Science Center
Atlantic Oceanographic and Meteorological Laboratory
Environmental Technology Laboratory
Geophysical Fluid Dynamics Laboratory
National Climatic Data Center
Office of Global Programs
Naval Research Laboratory
Office of Naval Research
U.S. Department of Agriculture
USDA, Forest Service Research
U.S. Department of Energy
U.S. Department of Energy Laboratories
Argonne National Laboratory
Brookhaven National Laboratory
Idaho National Engineering and Environmental Laboratory
Kansas City Plant
Lawrence Berkeley National Laboratory
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
National Energy Technology Laboratory
National Renewable Energy Laboratory
Oak Ridge Institute for Science and Education
Oak Ridge National Laboratory
Pacific Northwest National Laboratory
Princeton Plasma Physics Laboratory
Sandia National Laboratories
U.S. Department of Health and Human Services
Agency for Healthcare Research and Quality
Centers for Disease Control and Prevention
National Center for Health Statistics
National Institutes of Health
National Cancer Institute
National Institute of Allergy and Infectious Diseases
National Institute of Child Health and Human Development
National Institute on Alcohol Abuse and Alcoholism
National Institute on Drug Abuse
Office of International and Refugee Health
Office of Global Health Affairs
U.S. Department of the Interior
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S. Department of State BioIndustry Initiative
U.S. Environmental Protection Agency
Office of International Activities

BIOGRAPHY FOR WILLIAM A. WULF

Education:

B.S.—Engineering Physics, University of Illinois, 1961

M.S.—Electrical Engineering, University of Illinois, 1963

Ph.D.—Computer Science, University of Virginia, 1968

Descriptive Biography:

Dr. Wulf is a University Professor and the AT&T Professor of Engineering and Applied Science at the University of Virginia. Among his activities at the University were a complete revision of the undergraduate Computer Science curriculum, research on computer architecture and computer security, and an effort to assist humanities scholars exploit information technology.

Dr. Wulf was on leave from the University from mid 1996 to mid 2007 to serve as President of the National Academy of Engineering. Together with the National Academy of Sciences, the NAE operates under a congressional charter and presidential executive orders that call on it to provide advice to the government on issues of science and engineering.

In 1988–90 Dr. Wulf was on leave from the University to be Assistant Director of the National Science Foundation (NSF) where he headed the Directorate for Computer and Information Science and Engineering (CISE). CISE was responsible for computer science and engineering research as well as for operating the National Supercomputer Centers and NSFNET (the precursor to today's Internet). While at NSF, Dr. Wulf was deeply involved in the development of the High Performance Computing and Communication Initiative and in the formative discussions of the National Information Infrastructure.

Prior to joining Virginia, Dr. Wulf founded Tartan Laboratories, a software company, and served as its Chairman and Chief Executive Officer. Before returning to academe, Dr. Wulf grew the company to about a hundred employees. Tartan developed and marketed optimizing compilers, notably for Ada. Tartan was sold to Texas Instruments in 1995.

The technical basis for Tartan was research by Dr. Wulf while he was a Professor of Computer Science at Carnegie-Mellon University, where he was Acting Head of the Department from 1978–1979. At Carnegie-Mellon Dr. Wulf's research spanned programming systems and computer architecture; specific research activities included: the design and implementation of a systems-implementation language (Bliss), architectural design of the DEC PDP–11, the design and construction of a 16 processor multiprocessor and its operating system, a new approach to computer security, and development of a technology for the construction of high quality optimizing compilers. Dr. Wulf also actively participated in the development of Ada, the common DOD programming language for embedded computer applications.

While at Carnegie-Mellon and Tartan, Dr. Wulf was active in the "high tech" community in Pittsburgh. He helped found the Pittsburgh High Technology Council and served as Vice President and Director from its creation. He also helped found the CEO Network, the CEO Venture Fund, and served as an advisor to the Western Pennsylvania Advanced Technology Center. In 1983 he was awarded the Enterprise "Man of the Year" Award for these and other activities.

Consulting:

Stellar Computer, Pyramid Computer, Prime Computer, Westinghouse Research and Development, United Nations Development Program, IBM, Digital Equipment Corporation, Intel Corporation, Intermetrics Inc., North Electric Company, Cii Honeywell-Bull, Computer Networks Inc., NCR, Univac, and others.

Administrative Experience:

President, National Academy of Engineering, 1996–2007.

Assistant Director, National Science Foundation, 1988–90.

Chairman & CEO, Tartan Laboratories Incorporated, 1981–1987.

Acting Head, Department of Computer Science, Carnegie-Mellon University, 1978–1979.

Selected Professional Activities:

Member, National Academy of Engineering

Member, American Philosophical Society

Fellow, American Academy of Arts and Sciences
Foreign Fellow, Australian Academy of Science, Technology and Engineering
Foreign Member, Russian Academy of Sciences
Foreign Member of the Chinese Academy of Engineering
Foreign Member, Engineering Academy of Japan
Honorary Member, Academy of Technical Sciences of Romania
Corresponding Member, Royal Spanish Academy of Engineering
Member, Academy Bibliotheca Alexandrina (Library of Alexandria)
Foreign Corresponding Member, National Academy of Engineering of Venezuela
D. Sc. (Hon.) Carnegie Mellon University
D. Sc. (Hon) U. Connecticut
D. Engr. (Hon) Colorado School of Mines
D. Engr. (Hon) Polytechnic University
D. Engr. (Hon) Missouri University of Science and Technology
Distinguished Service Medal, U. Pennsylvania
Kenneth Andrew Roe Award, ASEE
Ralph Coats Roe Award, ASME
Distinguished Career in Science Award, Washington Academy of Sciences
Associate Editor, Acta Informatica
Reviewing Editor, *Science,* 1992–96
Chairman, Computer Science and Telecommunications Board, National Research Council, 1991–6
Member, Council of the ACM, 1991–98
Director, Computing Research Association, 1988–92
Member, Board of Visitors, Software Engineering Institute, 1987–93
Editorial Board, Addison-Wesley/SEI Series on Software Engineering
Member, Air Force Science Advisory Board, 1989–91
Director, Baker Engineers (a public Engineering firm), 1984–97
Director, Charles Starke Draper Laboratory, 1998–2006
Director, National Action Council for Minorities in Engineering, 1997–2007
Director, Anita Borg Institute for Women and Technology, 1999–(Chair beginning 7/1/08)
Trustee, Library of Alexandria (Egypt), 2001–2007
Member, Eta Kappa Nu (EE Honary Society)
Member, NSF Engineering Advisory Committee, 2007–present
Member, Purdue School of Engineering Advisory Board, 2007–present
Vice-Chair, Olin College President's Advisory Committee, 2007–present
Director, Civilian Research and Development Foundation, 2008–present
Director, MASDR Institute (Abu Dhabi), 2007–present

Professional Society Memberships:

Association for Computing Machinery, ACM (Fellow)
Institute of Electrical and Electronic Engineers, IEEE (Fellow)
American Association for the Advancement of Science, AAAS (Fellow)
American Society of Mechanical Engineers
Sigma-Xi
Association for Women in Science (Fellow)
International Engineering Council (Fellow)

Patents:

U.S. Patent No. 4,819,155 "Apparatus for Reading and Writing From Memory Streams of Data While Concurrently Executing a Plurality of Data Processing Operations"
U.S. Patent No. 6,154,826 "Method and Device for Maximizing Memory System Bandwidth by Accessing Data in an Dynamically Determined Order"

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Chairman BAIRD. Thank you. Dr. Calvin.

STATEMENT OF DR. JAMES A. CALVIN, INTERIM VICE PRESIDENT FOR RESEARCH; PROFESSOR OF STATISTICS, TEXAS A&M UNIVERSITY

Dr. CALVIN. Chairman Baird, Ranking Member Ehlers, and Members of the Subcommittee, I am honored to be able to represent Texas A&M University and testify about the role of non-governmental organizations and universities.

Texas A&M has a long history of supporting the three-fold mission of research, teaching, and public service and globalization of research and education is a natural extension of this traditional mission. Through globalization, Texas A&M has been able to produce graduates that are better prepared to compete within the global marketplace, recruit top-level faculty, and leverage local and national research support while at the same time further developing a positive international reputation.

To support these numerous international exchanges at Texas A&M, we have over 130 active international Memoranda of Understanding and are currently in the process of formalizing nearly 30 additional MOAs. Of note is our branch campus in Doha, Qatar, where we offer four undergraduate engineering degrees with graduate programs soon to be established. This campus is supported by the Qatar Foundation, and so no taxpayer or tuition money is used

to support this effort. Significantly, the curriculum requirements are the same as in College Station. Thus, undergraduate students must complete six hours in American history and six hours in political science in order to graduate.

The workplace and the scientific landscape have become increasingly global. No country can maintain a monopoly on scientific discoveries or on a trained work force. Thus, it is incumbent upon universities such as Texas A&M to engage this global environment so that we can lead instead of follow.

Employers of our graduates tell us that they want employees with global perspective. Providing international experiences to over 46,000 students is difficult if we limit ourselves to only sending students to foreign locations. Having more than 4,000 international students on our main campus allows Texas A&M a significant opportunity to create global experiences for a broad set of our students within the College Station environment.

A unique example of this involves the current president of Panama and a former student of Texas A&M. As a result of the Panamanian President's experience, he has promoted increased student and faculty exchanges with Texas A&M as a mechanism to help increase competitiveness of Panamanian universities.

Scientific discoveries come from all over the globe. In many cases, these efforts are most effective if they involve global collaboration. Although we have relationships around the world, we have chosen to focus particular emphasis on three regions, the Middle East, Asia, and Latin America. Here are some selected examples of such partnerships and their benefits. We have an agreement with Mexico's National Council of Science and Technology, or CONACYT, which is their equivalent of our National Science Foundation, that was formally established in 2002. Texas A&M and CONACYT have invested over $2.2 million in 93 new collaborative research teams involving investigators from both Texas A&M and Mexico. In fact, the partnerships are only funded if they are equally supported by both Texas A&M and Mexican researchers, and they cover topics of interest to both Mexico and the United States, from Cross-Border Land and Water-Use Changes to Diabetes and Cardiovascular Disease to Electric Energy by Alternative Renewable Resources.

Texas A&M, the George Bush Presidential Library Foundation, and the Chinese People's Association for Friendship with Foreign Countries have hosted three China–U.S. Relations Conferences that have helped expand academic and business opportunities and strengthen one of our most important global relationships. Through this conference, Texas A&M is helping to promote continued dialogue, at all levels, and encourage the development of strong partnerships in areas of joint interest.

Our campus in Qatar provides us with a remarkable opportunity to provide help in producing an increased engineering workforce in the Middle East while simultaneously providing research opportunities to work on problems of global interest. During this past year, Texas A&M University Qatar faculty received grants from the Qatar National Research Foundation for approximately $12 million to pursue research topics in engineering, the physical sciences, and

mathematics, all on topics that are of equal interest to Texas and the United States.

Our new Institute for Applied Mathematics and Computational Science is a partnership with the King Abdullah University of Science and Technology, or KAUST, located in Saudi Arabia. Through this $20 million effort funded by KAUST, Texas A&M faculty will be working on problems that are of fundamental importance while simultaneously helping to establish a new higher education institution built on the western educational model. The institute is part of a global research alliance that currently includes only three other centers located at Stanford, Cornell, and Oxford.

Finally, Norman E. Borlaug, winner of the Nobel Peace Prize, Presidential Medal of Freedom, and the Congressional Gold Medal, is a Distinguished Professor of International Agriculture at Texas A&M. The Borlaug Institute is assisting other nations to combat world hunger through technical innovation, training of agricultural scientists and workers, and intellectual leadership. There are currently 15 Texas A&M personnel serving throughout Iraq working in cooperation with USAID, USDA, and DOD.

In addition to what was said previously, there are three areas of interest that I think are quite significant in the way that universities can support the efforts of Texas A&M and all universities.

The first, as has been mentioned before, is the visa process. While national security issues are clearly a high priority, efforts to enhance appropriate international intellectual changes still need to be encouraged. An important way the Federal Government can provide unique support is through the development of new programs that effectively provide joint funding for international collaboration. Many partnerships can be initiated through a number of local capabilities, but to move the successful ones to the next level of progress, we really need funding that is able to provide resources as was previously mentioned to partnerships regardless of their location.

This includes support for American students wishing to study abroad as well as the international research efforts that I have discussed. And if these resources can be made available, the funds for the international research efforts should be committed for the long-term so investigators can make the commitment required to make important advances in these new programs and so that our international collaborators know that they can depend upon our participation as they develop and commit their share to such a funding model.

And finally, we believe it is important that as we begin these new initiatives, scientific peer review is a driving force behind the allocation of resources. It is through the competitive processes that we have developed as a country that the best science can be performed and given into the most effective hands.

Thank you.

[The prepared statement of Dr. Calvin follows:]

PREPARED STATEMENT OF JAMES A. CALVIN

Mr. Chairman, Ranking Member Ehlers, and Members of the Subcommittee, my name is James Calvin, and I am the Interim Vice President for Research at Texas A&M University. Good morning and thank you for including me in this prestigious list of speakers. I am honored to be representing universities in testifying about the

role of non-governmental organizations and universities in international science and technology cooperation.

Background

As one of the select few universities with the land-, sea- and space-grant designations, Texas A&M has a long history of supporting the three-fold mission of research, teaching, and public service at a research intensive university. The globalization and diversification of research and education is a natural extension of this traditional mission and is in fact one of the University's key imperatives outlined in *Vision 2020,* the University's effort to attain consensus top-ten status among public universities by the year 2020. Through its globalization and diversification efforts, Texas A&M is able to provide a more well-rounded education for our students, ensure that our faculty have the ability to engage in collaborative research with the leading researchers throughout the world, and promote Texas A&M as a research hub that encourages the best and the brightest from around the world to pursue their education within the United States. The result of these efforts is that Texas A&M has been able to produce graduates that are better prepared to compete within the global marketplace, recruit top-level faculty members, and leverage local and national research support through international partnerships as well as further developing a positive international reputation.

Demographics

Texas A&M has a student population of 46,542 (37,357 undergraduate and 9,185 graduate students) studying in over 250 degree programs in 10 colleges. Among these students, we have 4,025 international students from 124 countries. While a great number of these students come from Mexico, China, Taiwan, South Korea, and India, we also have students from Bhutan, Croatia, Eritrea, Macao, Yemen, and Togo.

During this academic year, Texas A&M hosted 577 foreign faculty scholars, representing 74 countries. Many of the faculty come to Texas A&M as a result of the relationships established through formal Memoranda of Agreement (MOA), while others visit our campus as a result of personal relationships with Texas A&M faculty established through usual scientific exchanges. Today, we have 132 active MOAs with universities and research institutions in 45 countries. We are also currently in the process of formalizing nearly 30 additional MOAs.

Texas A&M operates a branch campus in Doha, Qatar offering four undergraduate engineering degrees in Chemical, Electrical, Mechanical and Petroleum Engineering. In addition, research and graduate programs will soon be established at the Qatar campus. This campus is supported by private funding, as the Qatar Foundation underwrites our efforts in Doha. No taxpayer or tuition money is used to support this effort. When offering a degree from Texas A&M, either in College Station or in Doha, the curriculum requirements are the same. Thus, undergraduate students must complete six hours in American history and six hours in political science.

We also maintain two overseas centers in Italy and in Mexico City and are currently establishing a third center in Costa Rica. The University is also a part of the network of 27 federally funded national centers for International Business Education and Research, maintains an Office for Latin American Programs and an Institute for Pacific Asia and has received funding from the European Commission to establish one of the 10 European Union Centers of Excellence in the United States.

Although Texas A&M has research and educational relationships all over the world as well as the physical presences in Mexico, Italy, Qatar and Costa Rica, we have chosen to focus particular emphasis on three regions: the Middle East, Asia, and Latin America.

Role and benefit to Texas A&M of participating in international research and education cooperation

The workplace and the scientific landscape have become increasingly global. No country can maintain a monopoly on scientific discoveries or on a trained work force. Thus, it is incumbent upon universities such as Texas A&M to engage this global environment so that we can lead instead of follow. The value of globalization can be seen in all three components of our mission-research, teaching and public service. Because of Texas A&M's commitment to diversity and globalization and its varied international initiatives, we have better prepared students, globally competitive research programs, and a long history of giving back to the world community. Our graduates are better prepared, more rigorously trained and have a broader perspective upon which to draw as they enter the marketplace. Our research efforts

have a broader impact and the resources that can be used for research are leveraged. The area where impact is arguably the greatest, but the least mentioned, is within the realm of public service. By working on problems of bilateral or multi-lateral interest, we can help to develop solutions to practical problems that can provide immediate impact and provide an avenue for economic development. All of this allows Texas A&M to provide increased capabilities and value to the state and the Nation, while simultaneously helping to develop strong partnerships with our key regions of collaboration.

Our various study abroad programs and opportunities as well as our efforts at our international campuses and centers in Qatar, Mexico, Italy and our emerging campus in Costa Rica play vital roles in helping our students prepare for life after graduation. However, providing international experiences to 46,000-plus students is an inconceivable mission if we limit ourselves to only sending students to foreign locations. Having more than 4,000 international students on our main campus allows Texas A&M a significant opportunity to create global experiences for a broad set of our students and provides experience possibilities that do not require students to be able to afford the additional cost of a student abroad opportunity. For example, the Muller International Host Program (MIHP) was started by some students out of the Academy for Future International Leaders who started by taking international students home for holidays. The purpose of MIHP is to provide international students the opportunity to interact with a local family from the United States. This allows students to gain a better understanding of U.S. cultures and values. MIHP also provides international students with an informal atmosphere in which they can ask questions about U.S. customs, culture, and society. By acknowledging that international students are a welcome part of the Texas A&M community, MIHP deepens the relationship between international students and the Texas A&M community. MIHP also increases international students' knowledge of U.S. social institutions, promotes a better understanding of issues facing the international community, and provides international students a reference for casual U.S. dining. In exchange, the international students also have a chance to discuss their own cultures and social customs and bring the international experience home to their host families. Most importantly, MIHP lowers cultural barriers.

These invaluable educational experiences prepare our domestic students for jobs with multinational companies and the ability to perform under a wide variety of environments and with a diverse workforce and potentially diverse clientele. With a welcoming and nurturing global campus, the international student population, in turn, learns the merits and perspectives of the U.S. educational system and allows Texas A&M to cultivate relationships with individuals who become influential leaders back in their home countries. The current President of Panama is a former student of Texas A&M. As a result of Panamanian President Martin Torrijos Espino's experiences at Texas A&M, he has promoted formal student and faculty exchanges with Texas A&M as a mechanism to help increase the competitiveness of Panamanian universities.

Many areas of national need, for example the STEM fields of Science, Technology, Engineering and Mathematics, have a shortage of students. While it is imperative that we increase the number of U.S. students pursuing training in these areas, international students also provide a resource that can help drive the University's research agenda and provide trained graduates to meet the needs of U.S. employers. It is important to recognize that in addition to providing needed expertise to employers, international students often become entrepreneurs that add to the vitality of the U.S. economy and provide employment for many U.S. citizens.

Scientific discoveries are coming from all over the globe. In addition, many scientific challenges, such as effective alternative energy supplies and new breakthroughs in the life sciences require multi-disciplinary teams. In many cases, these efforts are most effective if the collaborations involve global partnerships. These partnerships can also leverage the resources of a Texas A&M faculty member as the global partner brings resources to the collaboration. The benefits of these partnerships will be both scientific and economic.

Oversight of the relationships that are established is an important aspect of any multi-institutional partnership. When educational experiences of our students are involved, these mechanisms require additional effort. Each MOA that is signed must go through a rigorous review process that ensures multiple institutional officials review the agreement. At Texas A&M this is monitored at the highest levels. In the case of our branch campuses, we maintain on-sight staff that is charged with the oversight of the student experiences. In the case of the Qatar campus, we maintain a full academic administrative structure to ensure that the experiences students receive replicate the ones that they would receive if they were on the main campus.

Existing research and science education programs

As was mentioned earlier, we maintain a large number of international relationships that span a wide variety of disciplines and levels of engagement, from person-to-person relationships to major institutional commitments to international consortia. A long-standing example of our effective partnerships is the bilateral agreement we have with Mexico's National Council of Science and Technology (CONACYT). Through this partnership formally established in 2001, Texas A&M and CONACYT have invested over $2.2 million in collaborative research teams involving investigators from both Texas A&M and Mexico. The 93 projects funded so far through this program have established new collaborations, provided support for numerous students (from both Mexico and Texas A&M) and provided the seed funding needed to initiate collaborations that could not have been established without this support. The topics of the research are quite varied and of major interest to both Mexico and the United States, from Cross-Border Land and Water-Use Changes to Diabetes and Cardiovascular Disease among Mexicans and Mexican Americans to Electric Energy by Alternative Renewable Resources. Another example of the benefits of this program is the team of researchers who are working a multi-year bovine tuberculosis project. This funding not only allowed the research team from Texas A&M and from Mexico to look for a solution to a serious health problem that affects both animal and human populations along the U.S.–Mexico border, but also enabled graduate students to work along side the counterpart investigators in a meaningful way. As can be seen, this partnership is leading to not only scientific advances, but the potential for the outcomes to provide stimulus to the economic development of the Texas–Mexico border.

Our campus in Education City in Doha, Qatar provides us with a remarkable opportunity to help provide an increased capacity to develop an engineering workforce in the Middle East while simultaneously providing research opportunities to work on problems of interest to Texas, as well. An important aspect of the efforts in Education City is that this is a co-educational environment that promotes men and women learning and working in the same environment. During this past year, faculty at Texas A&M–Qatar received grants from the Qatar National Research Foundation (QNRF) for approximately $12 million to pursue research in topics in engineering, the physical sciences, and mathematics. In addition, our engagement in Education City has led to separate research opportunities for our Colleges of Education and Human Development and Liberal Arts.

The College of Education and Human Development was invited to collaborate with the University of Qatar to set standards for their teacher training programs. Qatari graduates from this joint program will be competent, motivated teachers prepared to train students to achieve at the highest international standards.

In addition to traditional international research partnerships, Texas A&M is also involved with three examples of novel cooperative relationships. Texas A&M University, the George Bush School of Government and Public Service, the George Bush Presidential Library Foundation, and the Chinese People's Association for Friendship with Foreign Countries have hosted three China–U.S. Relations Conferences that have helped expand academic and business opportunities and strengthen one of the most important global relationships. As has been noted by President George H.W. Bush, China is our most important bilateral relationship. Through this conference, Texas A&M is helping to promote continued dialogue, at all levels, and encourage the development of strong partnerships in areas of joint interest. On the scientific side, this biennial conference series brings together scientists from the United States, primarily Texas A&M and China, to identify ways to work on problems facing both countries. A recent example of a successful collaboration is the project comparing the Yangtze and Mississippi River basins related to global climate variability and coastal ecosystem change.

Additionally, Texas A&M has received a significant grant from the U.S. Department of Defense (DOD) to help strengthen the ability of future military officers in language and cultural competency. The grant, part of the 2008 Reserve Officer Training Corps (ROTC) Language and Culture Project, is sponsored by the National Security Education Program, on behalf of the Defense Language Office, and will be used to create on-campus as well as overseas programs to enable students in the Corps of Cadets to gain greater exposure to the Chinese and Arabic-speaking worlds, as well as to create courses and other programs to improve language skills.

A second novel partnership is our new Institute for Applied Mathematics and Computational Science (IAMCS), which is a partnership with the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia. Through this $20 million effort funded by KAUST, faculty at Texas A&M and its partner institutions will be working on problems that are of global importance while simultaneously, like Qatar, helping to establish a new higher education institution built on the western

educational model. IAMCS is part of a global research alliance that includes only three other centers at Cornell University, Stanford University, and Oxford University. The research resulting from IAMCS will be open to peer review and published in the highest quality journals. We will develop new results that both advance the disciplines within mathematical and computational sciences, but also work on recurring annual themes, such as Earth science and material science to help solve problems that will impact multinational audiences.

Finally, Norman E. Borlaug, winner of the 1970 Nobel Peace Prize, the 1977 Presidential Medal of Freedom, and the 2006 Congressional Gold Medal, is a Distinguished Professor in International Agriculture at Texas A&M. As the largest center for agriculture and life sciences in the world, Texas A&M Agriculture is—by virtue of mission and vision—uniquely poised for a new era of global leadership. Texas A&M's Borlaug Institute is assisting other nations to combat world hunger through technical innovation, training of agricultural scientists and workers, and intellectual leadership.

Current projects related to Iraq and Afghanistan include a $4 million USAID project for range management in Afghanistan, the $6 million USDA IAER program to improve agricultural extension in Iraq, and a $10 million USAID subcontract on the Inma Agribusiness program to build agribusiness in Iraq. The Institute's work began in Iraq in 2003 with crop technology demonstrations and extension support under the USAID Agricultural Reconstruction and Development for Iraq (ARDI) project based in Baghdad and Erbil. The Institute has had long-term agricultural specialists in Iraq from 2003 until the present.

Resulting from previous and current experience in Iraq, Texas A&M personnel are acquainted with Iraqi universities, government agencies, industries, businesses, infrastructure, leaders, natural resources and agricultural production technologies. There are currently 15 Texas A&M personnel serving throughout Iraq working in cooperation with USAID, USDA, and DOD. We are engaged in private sector economic development, collaboration with educational institutions, and providing science-based solutions for the rehabilitation of the Iraqi agricultural sector.

Federal interaction and support

While the visa process is the most obvious example of interaction between Texas A&M and the Federal Government, we also actively engage federal sponsors and the peer reviewed mechanism to obtain funding to support our initiatives. In many cases, these funds are then leveraged by private or international sources. In the case of the China–U.S. Relations Conferences, we have actively involved cabinet level officials or their representatives to provide keynote addresses.

In looking at the broad perspective of global collaboration, one way the Federal Government can provide unique support is through the development of new programs that effectively provide funding for international collaboration. At this time, collaborations can be initiated through a variety of mechanisms, such as our partnership with CONACYT, but long-term funding for the most promising collaborations is extremely difficult to obtain. In most cases, such success involves each collaborator searching for funding independently in their home countries and hoping that both can find funds during the same funding cycle. Given the current rigorous competition for existing research funding, it appears that new resources would be required for such a program so that existing high priority initiatives are not impacted.

If resources can be made available, we feel that the funds should be committed for the long-term so that investigators can make the commitment required to make important advances in these new programs and so that our international collaborators know that they can depend upon our participation as they develop and commit their share of such a funding model.

It would seem natural that prioritization of research programs would be necessary to ensure sufficient resources to make an impact. A broad dialogue will be important in determining what these priorities are and ensuring that both scientific preeminence and economic impact will have a role in determining the topics that are chosen. It is important, however, that the scientific peer review process drive the allocation of the resources once the priorities are established to ensure credibility within the scientific community and the best possible science.

I thank the Committee for the important work they do for U.S. scientific research, and specifically, their interest in this important topic.

BIOGRAPHY FOR JAMES A. CALVIN

James A. Calvin earned his doctorate and Master's of Science degrees in statistics from Colorado State University in 1985 and 1980, respectively. Dr. Calvin received his Bachelor of Science degree in computer science and mathematics from the University of Oregon in 1976. Upon earning his doctorate, he held the rank of Assistant Professor in the Department of Statistics and Actuarial Science at the University of Iowa from 1985 to 1991 and held a secondary appointment in the Division of Biostatistics from 1988 to 1991.

Dr. Calvin Joined the Texas A&M University faculty in 1991. From 1998 to 2004, he was Professor and Head of the Department of Statistics with secondary appointments in veterinary anatomy and public health, epidemiology and biostatistics, and toxicology. In 2001, he became an Associate Vice President for Research and was appointed as the Executive Associate Vice President for Research in 2004. He has served as Interim Vice President for Research since September 2007.

Dr. Calvin's research interests include linear models, multi-variate variance components, biostatistics, measurement error, spatial models, and statistical process control. He is the principal investigator for the Texas A&M Institute for Applied Mathematics and Computational Science. The new institute, funded by King Abdullah University of Science and Technology in Saudi Arabia, will engage mathematicians, statisticians and computer scientists on problems that span the Earth sciences, materials science and the bio-sciences. Applications include reservoir modeling, thermo-acoustic and photo-acoustic imaging related to disease diagnosis, gene expression modeling and complex data, including seismic and genomic information.

Dr. Calvin has served on several editorial boards, including *Biometrics,* where he served as Executive Editor, the *Journal of the American Statistical Association, Communications in Statistics* and the ASA–SIAM Series on Statistics and Applied Probability. Dr. Calvin is a fellow of the American Statistical Association and an elected member of the International Statistical Institute. He has directed seven successful graduate students and authored numerous publications.

DISCUSSION

Chairman BAIRD. Thank you all for outstanding testimony. We much appreciate it.

We will now begin the questions, and I will recognize myself for five minutes, and we will follow with Dr. Ehlers. We have been joined by Dr. McNerney from California. Dr. McNerney, thank you for joining us and for your service on this committee.

I want to begin by addressing what we heard from a number of you, the issue of visas. This committee has had a hearing on this, and the good news that we are told that the visas are improving. The bad news is there is still a lot of challenge both in terms of the reality of whether they are being processed quickly enough and also the perceptual realities internationally about the difficulties people face. We have had both hearings publicly here but also private meetings with a number of people from various Homeland Security and related departments, and we are continuing to work on that. The point is well-taken, and we are working on that.

Also, I want to begin also by congratulating you, Dr. Leshner, on the Center for Science Diplomacy. And we are honored that you would announce that here and perhaps you have announced it elsewhere, but it is——

Dr. LESHNER. No, today is the day.

Chairman BAIRD. Is that right?

Dr. LESHNER. This is the moment.

Chairman BAIRD. It is perfect. Great minds think alike I guess, and I can't think of a better organization to do that. We will look forward to good things from the Center, and any way we can assist in that, we will be happy to and to celebrate your accomplishments.

Now, you also mentioned, Dr. Leshner, the importance of the Foreign Relations Committee. Howard Berman is quite interested in this issue. We have had a number of conversations with him and his staff. They have been sitting in on meetings, and our hope is really to kind of set the table here through this series of hearings we have been having and then work in very close concert with Chairman Berman and also with Nita Lowey. They both appreciate the value of this and have some great staff working on this issue, and we are eager to work with them on that.

I want to ask a few questions if I may. This issue repeatedly mentioned in your testimony about the restrictions on U.S. funds to go to foreign researchers, a couple questions emerge. One, we have the Fulbright Program, predominantly to bring folks here, but do we need something like that where we would fund foreign researchers in their home countries with U.S. dollars? You don't necessarily want to dilute the NSF monies, but how would we do it? If you could devise a program, what would it look like? And we will hear from all the witnesses.

Dr. LESHNER. Perhaps I will start. I would say that from my own perspective, the only conditions under which I would support research in a foreign country without an American collaborator is if in fact it was something we really needed to know and we were confident it was something that was not going to happen in the United States.

Chairman BAIRD. Let us assume we have a U.S. collaborator.

Dr. LESHNER. Right. So when we have a U.S. collaborator, often, particularly in developing countries, the foreign collaborator can't afford to provide the resources for their part of their research. If we're serious about fostering collaboration and if we have a serious motivation towards helping in infrastructure development in other countries, particularly in the developing world, then I think we have an obligation to provide at least minimal support. The big issue, however, in the diplomacy aspect of this is to make sure that these are not just one-shot, one-year investments. If we are serious about building infrastructure, we have to be willing to sustain it and maintain it at least for a while over time.

Chairman BAIRD. Very good point.

Dr. CLEGG. I agree with Alan's points, but let me add that in my capacity with the National Academy of Sciences, I travel around the world very frequently and meet with the leadership of science of most of the countries of the world, and it is remarkable the number who have had experiences in the United States. Most of them speak English, they know our culture much better than we know theirs, they are very good interpreters of our society in their own environments, they are our friends. Typically they desire to collaborate with us. This is a huge investment that began after World War II and continued up until the late '80's but after that has declined substantially. These assets will not be there. This generation is passing from the scene. We will not have the kinds of contacts and people who are familiar with our scientific institutions and our society more broadly in the leadership of science internationally in the future.

So I would urge that one important step is to begin to re-establish the support for international graduate studies from developing

countries, not from the developed countries but from developing countries where we can continue to benefit from this personal exchange.

Chairman BAIRD. Dr. Wulf.

Dr. WULF. Several points I would like to make. First of all, the issue of funding foreign scientists to do research in their own countries is what CRDF does, funded by NSF, the State Department, Department of Energy, Department of Defense, and NIH. The original goal was to fund foreign scientists. This is something that an NGO can do. It is not so easy for the Federal Government to do.

Second, I would like to amplify just a little bit on your comment about visas in two dimensions. First of all, I think all of us sitting at this table travel a good deal overseas, and a common reaction that I get from my colleagues overseas is "what are you doing?" We are shooting ourselves in the foot, although I know that the average time it takes for a student visa to clear has gone from several months down to less than two weeks. That is not the story that plays on the front page of the newspapers overseas. It is the rare but newsworthy case where it takes six months or we deny a visa to a renowned scientist.

There is a second problem, and that is the problem of "deemed exports." I had the privilege of serving on the Department of Commerce Committee to look at the question of deemed exports, but unless something changes, we could wind up in a situation in which no foreign student is allowed to do any research at a university in the United States. It is a very serious problem. Our Committee submitted its report to the Secretary of Commerce back in late December or early January. I think they have been working on it. But there may be legislative action that is required as well, and so I would urge you to think about that.

And finally, I would like to just reiterate some of what Mike said about the goodwill that we have engendered overseas because of the foreign students who have been here. Mike and I were both in Iran in October, and it is just hard to explain how much the faculty at places like Sharif University, which is sort of their MIT, like Americans, understand our values, admire our values, and are some of the best ambassadors that we have in the entire world. So this is gold.

Chairman BAIRD. Dr. Calvin?

Dr. CALVIN. I think many of the points have already been mentioned, so I don't want to duplicate them, but two things I think are important to recognize is one, not all countries we want to engage in national partnerships are the same. And so a model that may work well in many developing countries isn't necessarily the right model to engage China, for example. And so I think we need to come up with a broader perspective on the issue of how we approach the problem.

Second, I think it is important from a scientific standpoint that we need to have a model so that the money goes where it goes where it needs to go to get the science done. And if that is in on relocation or the other, it shouldn't be the issue. Is the science getting done and is the effective partnership in place to make that science work appropriately. And if we pay attention about quotas on one side or the other, we eventually find that there is inefficien-

cies in the system that doesn't allow us to get as much bang for our buck as we would like.

Chairman BAIRD. Dr. Calvin, I will close with one comment, and then recognize Dr. Ehlers, and that is that Dr. Clegg, you mentioned and others mentioned the importance of Mid-East applications of scientific diplomacy. One of the things I would hope we would also do, I think it is absolutely correct that our technological and scientific prowess is admired by Middle Eastern nations. I would hope we could also look at science diplomacy as leading to our recognition of the scientific history and contributions of Middle Eastern nations. One need only look at some of the early astrolabes created by Islamic scientists to realize that we owe a profound debt, algebra, zero, a few other things——

Dr. CALVIN. Right. Absolutely.

Chairman BAIRD.—to them, and we need to accentuate that awareness within our own culture I think as well.

With that, I recognize Dr. Ehlers.

Mr. BILBRAY. First I want to clarify that they hijacked that from India and from the Far East, too, so it was transmission of knowledge, not necessarily the discovery of it.

Mr. EHLERS. That was not me, by the way.

Chairman BAIRD. The Chair recognizes Dr. Ehlers.

Mr. EHLERS. Thank you. It just struck me when you said they gave us zero. They gave us zero and we give them nothing, and we think it is a fair exchange.

Thank you very much for your testimony. It has been very, very enlightening to me. I spent a year in Germany many years ago as a post-doctorate fellow supported by NATO, and I thought that was a marvelous program, especially to have some of our military money funneled into a good program like that. But also later on my research advisor, Bill Nuremberg—some of you know him, brilliant physicist, lots of energy, but also a good diplomat—he was appointed by the Department of State as the representative to NATO on the science level. And we did those things much more often back then.

I think we certainly have to return to that and we have to correct the visa problem, but I am very impressed, Bill, with the program you outlined and I didn't know much about it and I am pleased to hear about what you are doing. It is a very good way to do it.

One thing we did at Berkeley when I was on the faculty there, we took some students from Turkey and had them in our laps for a few years, and then one of our faculty members, one of my colleagues, spent some time in Turkey; and it was a marvelous experience because it made us realize how difficult it is to do research in a foreign country. And when my colleague was over there, almost every day I would get a telephone call, can you send me three O rings of such-and-such a size. It really was that bad. And we don't appreciate that enough, and I think having their students come here and letting our students and professors go there is really good in helping break the logjam in that. Some of the horror stories that I have heard from foreign scientists I have worked with, one ordered a marvelous new piece of equipment—this was many years ago, before bubble wrap and all those sort of things. It was packaged in a box with not foam insulation but micro light insulation

and paper. The customs official just sliced that open, filled the scientific equipment with all these little particles. It took them six months to clean it out. It is just endless problems to be dealt with.

I am just very pleased with what you said and the progress I see. I think we ought to work very hard at breaking down some of these barriers, and the first time I encountered it when I got here, I was asked to write this brief, little booklet on science policy. And one of the goals—I think I developed it with the assistance of the National Academy—was to get a scientist back in the State Department. Why that ever stopped, I don't know. But the difficulty of getting it restarted just amazed me. It seemed to me a self-evident thing. Fortunately it is under way now.

We have so much work to do in so many areas on this topic, and I am just glad you are there doing it. I don't really have questions, I just wanted to say I am very pleased with what you are doing, and keep it up. If there are things that we can do to help, please let us know. The visa question, Dr. Baird has done a great job on addressing that, but we know there are a lot of other issues we should be addressing. I would like to see a lot more exchange programs, not just the current situation where some students come here if they get the money and we send some people there, but an organized program with constant exchange, as we used to do with the Soviet Union.

I think I have time left, but I will set a standard for everyone, be the first one to close before the bell goes off. Thank you very much, Mr. Chairman.

Chairman BAIRD. Dr. McNerney.

Mr. MCNERNEY. Thank you very much, Mr. Chairman. I do want to thank you for pulling this together. It is a very important subject. And you know, as important as it is for the development of science and technology, it is also as you mentioned critical for just understanding international issues. I think science is the tool we can use to open up these barriers. And so I really encourage you and you colleagues to continue.

I have a couple of questions. First of all, how interested do you see multinational corporations being in developing an infrastructure for international scientific cooperation and collaboration?

Dr. WULF. CRDF has experienced substantial financial support from multinational corporations, both for research projects and also for education.

Mr. MCNERNEY. Are there particular sectors that you think are more interested in——

Dr. WULF. The energy sector has been very interested. The high-tech sector, it is an embarrassment that we are now a net importer of high-tech products. But yes.

Dr. CLEGG. I will just echo what Bill says. There is great interest because of the perception that markets are largely going to go abroad and not to the United States. And so American high-tech industries have a strong interest in developing relationships abroad. But their interests are largely driven by their business models and a need to deliver to their stockholders. But they aren't as interested I think in the long-term issues that we have tried to portray in our presentations.

Mr. MCNERNEY. Do you think that the standards of ethics and integrity are an important issue for scientific development in countries that have different cultures than us, I guess is a way to say that?

Dr. LESHNER. Sure, and more and more we are seeing evidence that as the global scientific enterprise becomes more unified, more integrated, we are seeing more and more efforts among countries to have those kinds of discussions very candidly. We have participated in an array of them, including with China who has invested tremendously, a tremendous amount of effort in trying to develop their own set of standards and regulations and have them being in keeping with the rest of the world. But it is an effort that has begun and needs to continue. I am sure that the Academies and the InterAcademy Panel have worked on these issues as well.

Dr. CLEGG. Let me just pick upon what Alan has said and also to relate it back to a comment that Bill made. As Bill mentioned, we have a program of workshops with Iran which are conducted on an annual basis. One of the first workshops that the Iranians wanted to have was on scientific ethics. But I would like to also return in the context of ethics to a broader point which is that science does operate within an ethical framework because you cannot do science without paying attention to the material evidence, and science has to be repeatable so it has to be honest. So there is an ethical basis to science which adds we believe to the temper of society, and therefore helping expand science and technology capabilities in other parts of the work also expands an ethical basis which is an important dimension of science.

Mr. MCNERNEY. Thank you. I am not sure who to ask this question or who to direct this question to. What do you think the limiting factors are in promoting global scientific cooperation and collaboration? What are the ultimate limiting factors? Is it political, is it economic, is it cultural, or is it something else that I haven't mentioned?

Dr. CALVIN. My experience is that—and of course, this is coming from a single institution—but there is no limitation in scientists' interest or willingness as long as the research is available for public peer review processes to find new partners and engage in new collaborations. What is limiting is mechanisms to provide introductions to those individuals and then the model so that if you can instigate a new partnership, you can actually follow through on your relationship. As it stands right now, if I have a colleague in another country, we have to go to separate funding mechanisms under separate funding cycles and hoping that we can make a case for something that is of interest to two, non-coordinated bodies to be able to push forward from an initial process. So it is this coordination of communication, and then a model that approves the partnership.

Mr. MCNERNEY. What you see is a bureaucracy, the bureaucratic hassle is one of the biggest factors, then?

Dr. CALVIN. I guess if you want to put it that way. You know, resources always become an issue at some point.

Mr. MCNERNEY. Of course.

Dr. CALVIN. But faculty members at our institution are aware of what is going on worldwide, and if they have a collaborator that

is anywhere in the world, they know how to get a hold of them and they have the international conferences to make the introductions. What they don't have is the mechanism to take the next step.

Dr. LESHNER. One of the things if I might just mention is that the European Commission opened its Framework Seven petition to people outside of the European Union, and we met with the Argentine Science Minister last week who very proudly pointed out the extent of Argentina's participation in Framework Seven. Well, that is not only a form of science diplomacy but it is certainly a mechanism that makes it a whole lot easier to develop international cooperation. And it is part of the reason why I am obsessed with the notion that we need to rethink the way in which we structure our own funding for international science diplomacy.

Mr. MCNERNEY. Thank you.

Dr. WULF. I can't not say that resources are also a limiting factor, which you didn't mention. I have been really impressed by the fact that CRDF's average grant to support foreign scientists and collaboration between foreign scientists and U.S. scientists is $60,000 over two years. Eighty percent of that money goes to foreign scientists, 20 percent to the United States. That is a tiny, tiny little bit of money and yet we have no problem finding U.S. scientists who want to participate. They do it because they think it is important, because they think it is a contribution that they can make to the world. You know, that is not the limitation, money is.

Mr. MCNERNEY. Speaking of limitations, I think I have run over my time a little bit, Mr. Chairman, so I yield back.

Chairman BAIRD. Fortunately, Mr. Ehlers had pre-yielded time. It is a time back that Mr. McNerney drew upon.

Mr. EHLERS. I may reclaim that.

Chairman BAIRD. Mr. Bilbray.

Mr. BILBRAY. Yes, Dr. Calvin, if you want to be frustrated by uncoordinated efforts, you should try to work with the Senate. Mr. Chairman, I apologize. I wasn't going to mention anything about the visa, but it really is a very important issue and I hope that today we can sort of understand that the Science Committee ought to be an advocate. But understand that the obstructionism that is caused at the visa process is not the problem. It is a symptom of a problem. Now, we all have heard back and forth the 9–11 terrorists were visa overstays, and we assume that the concept of checking like visa status whenever you let somebody into an educational institution is not the business of educationalized institutions, but then again, you have the 9–11 terrorist take a class in aviation and use it, and that is one of the problems. So I just hope that this Chairman or this committee becomes the perfect spokesman for the fact that our problem is that we are trying to do it all at the border. You know, we are trying to restrict those who come into our country, and what happens is the bureaucrat who is making these calls has a feeling that once I say okay, there is nothing to back me up afterwards. Forty percent of the people illegally in this country are visa overstays, and to a lot of people, their argument is the way you eliminate 40 percent of the problem is just don't allow any visas, and I don't think any of us wants to do that.

But I think that if we want to open up and make the system more rational, we have got to understand we got to stop taking the

political easy route of saying, let us do it all at the border, let us just not issue visas or let us tighten up the visa process. Rather than having a back-up system so that the agent who was given the visa can be assured that, look, somebody might slip through, they might overstay, but at least I know then that somebody is checking that they can't get a driver's license, they can't open a bank account, they can't get a job; and then I feel you are going to see the visa system much more. But historically, we have not been brave enough to address that. I mean, this week I think we are going to have a vote on e-verification. Very simple system, name and number matches. But even that people don't want to take the political heat for, so it ends up being easier politically to put it all on the visa system. And I think that as a child of an immigrant and watching my cousins trying to get into this country, that is one thing that we have got to open up. But if we want it opened up, then we have got to be willing to take the heat at having a backup system and that means doing these checks, to assure the visa application handler, you are not the only barrier between the American people and somebody who may come into the country or overstay.

But getting back to one of the things I am interested in is the use of water. I think one of the things we are missing is that water is going to be the most destabilizing element in the world in the future, more than oil, and especially from the Jordan to India from the Kurdistan down to the sub-Sahara. And the Muslim world is one of the biggest crisis. I am very encouraged with your work of getting Israel and Jordan working together because no one in the world has done more at conservation and application of water than Israel. Negative desert research with high salinity, that really could have a great diplomatic advantage of moving science but also getting two parts of that world working together, and if somebody who has worked since I was 25 years old working with Mexico on environmental economic issues, that is how you build relationships, is working at joint problems together. And can you elaborate on how you got Jordan and Israel working together?

Dr. CLEGG. Well, actually, it was Jordan, Israel, and Palestine, and we initially approached the parties to work on it on a scientific project of high importance, as a bridge-building mechanism to create understanding between the scientists in that conflicted region of the world. The initial focus was actually on health, but during the process the issue of water in the Jordan Valley which is a very contentious and difficult political issue came to the fore as one of the primary issues. So a committee of scientists representing all three entities, including also the United States, was put together under our sponsorship. We provided the money for the work and so forth, and that led to a book-length report that I cited in my written testimony called *Water for the Future.* This effort is slow. This kind of work is not easy because it means building trust and relationships among people where there is very little trust to begin with. That, however, has matured into a number of efforts on our part to work together with those three parties, including something called the frontiers of science for young and mid-career scientists of the Middle East which we have hosted twice now, once in Istanbul and most recently in Spain. This brings young and mid-

career scientists together for symposia on five quite distinct areas of science, to build relationships and understanding.

We also just had a meeting in January in Jordan on the Dead Sea with Palestine, Israel, and Jordan to focus on other areas of science that we can work on. Among them are micro-nutrient deficiencies which is a serious health problem in the Middle East, land degredation and pollution, water resources, education. But that takes resources, and virtually all of the support for these kinds of activities has come from private sources, either philanthropic sources or from our own institutional endowments. So what we can do is fairly limited.

So this allows me to come back to this question of resources. You cannot do things without adequate resources, no matter how good your intentions are. Resources are important.

The other key thing is that science can be an essential component of soft diplomacy and can help solve problems in all parts of the world. I would like to just say one word about our part of the world. Our activities also include Latin America. You cited Mexico. We did a joint study on water and the water issues facing the basin of the Valley of Mexico in Mexico City, together with the Mexican Academy of Sciences which has been influential in that country. We do continued water work in Mexico.

I just came from Central America on Sunday night. It is a disappointment to see that our national engagement and soft diplomacy in Central America is very little——

Mr. BILBRAY. Doctor, I totally agree with you. We have totally ignored Central America. We spent more time in Argentina than we do in Costa Rica or El Salvador.

Dr. CLEGG. The northern Europeans make bigger investment in science and technology diplomacy in Central America than does the United States despite the fact that this is a vital region, of vital interest to us. I will stop talking.

Mr. BILBRAY. Well, I will talk about that later.

Chairman BAIRD. We will begin the second round of comments and questions. Dr. Calvin, you were building kind of a line of thought earlier it seemed like and at the critical juncture paused and talked about, okay, so you have got U.S. researchers, foreign researchers, and I think you used the word there is a lack of a mechanism or some word like that. What would a mechanism look like? How would it be administered? What would you do if you want to promote scientific diplomacy, international collaboration? What would it look like?

Dr. CALVIN. Well, I think again, as I said before, it would depend somewhat on which area of the globe I was trying to promote this effort. I think if you take for example in China where we have had our three China-U.S. summits, what we have come out of this is we have a lot of debate and a lot of discussion, and we bring scientists together. Everybody is excited, and then after three conferences, we are still at the same stage because no one can find a good model to really move the projects to that next stage of discovery.

And so I think in the case of China, there is quite a reason to believe that we could work with the Chinese government to establish a jointly funded research capability that would allow for inves-

tigators to apply to an agency that would be financed by both countries potentially. I don't believe that we would want to make an argument that we would want to change the dedication of the existing resources at the National Science Foundation, for example, because they are woefully under funded from my perspective as they sit right now, and asking more and giving them less isn't a way to do anything better.

Beyond that, I don't have an effective mechanism because I am sure that the political aspects associated with getting anything through the channels of dialogue are far beyond my experiences and I couldn't advocate in an area where I have so little expertise.

Chairman BAIRD. The things I found intriguing was, you know, we have looked at some of the S&T agreements that our State Department has established. I think you said 130 MOAs? I think that is more than our government officially has with other countries—I don't mean that as a critical comment, more just it is—entity may have more international agreements than the Federal Government, and the administration of these things—they are a relatively small staff, tasked with creating these agreements, but the follow-up then becomes a problem.

I will share an anecdote with you, and I want to pursue this issue of funding and how we get around it or detail with it. My wife, who does international development work, was in an African country and they were talking about the relative small number of people some developing countries have who are expertise. In this particular African country, they had three water sanitation experts, one of whom died of AIDS and the two others were killed in a car wreck coming back from his funeral. And that was it. You know, in our country you just post an ad and you would get 50 applications and you would replace them. That was the entire country's water sanitation unit. This issue of capacity building is really critical, and one of the interesting questions I have is Dr. Wulf, you are an agent in the organization. It seems to be able to get money to foreign researchers, and yet, other U.S. Government entities seem not to be able to do that. Is this a desirable mechanism, are there better alternatives?

One of my questions is does it make sense for example for State or USAID to have a fund that while we don't dilute the NSF funds as Dr. Calvin I think I agree entirely with what he is saying, but nevertheless, an NSF-funded researcher could say, okay, I want to collaborate with Dr. So-and-SO in foreign country "X." Here is where we will go and everybody knows this is where we go. So I throw that question out.

Dr. WULF. My understanding is that there might be legal restrictions on NSF providing money to foreign researchers. I don't quite understand how this works, but they seem to be able to fund CRDF for programs that involve foreign researchers collaborating with U.S. partners. Actually, I think there are some advantages other than legal sleight of hand going on here. Because for example, CRDF can negotiate with foreign governments for cost-sharing arrangements. That is something that NSF or I think any federal agency may not be able to do as quickly. And we have been fairly successful at that. The foreign governments clearly recognize the

advantage of these collaborations and have demonstrated that with $43 million of cost sharing.

Chairman BAIRD. Let me follow up with just a question on this. You know, USAID, I think I actually support it, has made a real effort to brand. I mean, they have actually gone over the top a little bit. I think if you give toothpicks, you would have to find a gift to the American people on this toothpick. But nevertheless, the idea that in some way when we spend U.S. dollars internationally on an AID project, people get the sense that, yeah, this is U.S. dollars is a good thing for us. Our generosity should be recognized, I think. How does that translate into the work CRDF does?

Dr. WULF. I think foreign nationals recognize CRDF is a U.S. entity, just not the U.S. Government. And that again is somewhat of an advantage in places where the intentions of the U.S. Government are not necessarily trusted.

Chairman BAIRD. Dr. Leshner, you looked like you wanted to comment.

Dr. LESHNER. Yeah, I was just going to reiterate the last comment that Dr. Wulf made which is that often it is important to go through a third party or a non-governmental organization so that the sort of the neutrality of the motivation is clear. Was that English what I just said? It was an attempt at English. And I think because science carries this sort of aura around it, it is often important to make clear that the act of science diplomacy, either collaboration or for more general relationship building, is going on outside of a formal governmental framework.

Dr. CLEGG. With respect to Africa, I would like to say a couple of things. The first is the U.S. philanthropic community has created a large footprint in Africa. The Gates Foundation does support direct research in Africa. It is a very large and very significant player, as you know. There is also the Partnership for Higher Education in Africa which is funded by six of the major American philanthropic foundations. So the philanthropic community is a very important player in the creation of soft diplomacy for the United States, even though it is not part of the government. It is possible to leverage some of those activities, and it would be useful for the government to think through how it might leverage and take advantage of the good work being done by American institutions in other contexts.

Another point is that we, together with the science academies of the whole world, have created a global organizations. One of the messages of that global organization has tried to get across to all of the national members is that investments in human resources in science and technology capabilities within individual countries is an absolute necessity if they expect to participate in the economies of the 21st century, and that is a local responsibility. We cannot assume that responsibility, but we can work hard to try and get that message across and also to facilitate their movement in that direction through incentives.

Chairman BAIRD. Dr. Ehlers is recognized for 9-1/2 minutes.

Mr. EHLERS. At least. Thank you, Mr. Chairman. First, a couple of points. Getting to the question of our government supporting other scientists in other countries or doing other things, I had an experience with my family. My son is a geophysicist. I never real-

ized before he even became that how much they travel. At the moment he is in Bolivia doing some very esoteric experiments in rather dangerous territory, and he has also done research in British Columbia, about 300 miles from the nearest person. He had a commitment from a colleague in Germany to do some research together. The colleague obtained funds from the German government to do it if the U.S. would provide the money. My son submitted a grant proposal, could not get any money from the Federal Government to match a project with the German. That seems a bit strange to me. And of course, my personal ethics didn't allow me to intervene on his behalf, but I thought that was symptomatic of the real problem here.

The issue of resources, Dr. Clegg, you went into that a number of times, the resources in other countries. Are you talking about money or a lot of other resources because I gave you the example of my friend who was needing three O rings and things like that in a relatively advanced country. I think that is a major problem judging from the foreign scientists I have worked with. Just getting equipment, and I am not talking about getting money from the government to order equipment from the U.S., but I am talking about the mundane equipment that one needs every day in the laboratory. Have you encountered that as a major——

Dr. CLEGG. Oh, absolutely, particularly in travels in the developing world, in Latin America, in parts of Africa where the ability to put together a functional laboratory is inhibited by the lack of access and also the lack of maintenance for high-quality scientific equipment. That is a very big issue.

Typically when we say resources, we are talking money one way or the other. It is a nice way of saying money. But there are other resources which are absolutely crucial. One is access to the world's scientific literature. You cannot be as you very well know of an effective practicing scientist without access to the contemporary development of knowledge in a field. And the transforming technology of our era is electronic communication. It is now possible to access knowledge almost from anywhere in the world. There are just two barriers. One barrier is infrastructure, whether the scientists in a particular country have the infrastructure to get on the web and access the scientific literature, and the other is intellectual property issues associated with publishers like my friends. Being able to access the scientific literature, there are places where the U.S. Government could be of direct help. Creating digital scientific libraries where resources again were provided to buy site licenses that would allow people in poor countries to access the scientific literature. And we have worked together on programs in limited areas in that context. One is Pakistan where we found that we could purchase bundled site licenses at a huge discount. So it is possible to do those sorts of things.

Mr. EHLERS. Alan?

Dr. LESHNER. There is a large consortium called HINARI that provides free access to the world's scientific literature. There are a very large number of countries in the developing world that most major journals participate in. The point I wanted to add is the other, and it may be resources but it may not only be resources, is scientific careers, that is, that it has to be clear that there is a

career path in a developing country, that it is not just going to be a momentary opportunity or you won't be able to recruit the best and brightest into careers. Many countries now are working very hard and investing very hard to bring the scientists who train in the United States back home by providing career opportunities, and it is very effective. China, of course, is the best example of that at the moment. But other countries are doing this as well.

Mr. EHLERS. You know, I am reminded of a cliché. Forgive me. Churchill was supposed to have made the comment that America always does the right thing after they have done all the other things first. It seems to me that we are at a state where we should think seriously about doing this as a national effort in a coordinated way instead of having all of the different organizations doing this. And there are tremendous opportunities there. I wouldn't dare to put this in the State Department because they don't seem to understand the problem and the urgency. Are we going to give the charge to the National Science Foundation to do it? Not without increasing their budgets substantially. But we really have to think seriously about developing mechanisms rather than depending on the private sector or the National Academy, the universities, or whatever. There is immense international relations work to be done here, and the Federal Government is just not doing it. It is depending on you folks to do it, and that is not the most efficient way to get it done. So I hope we can pursue this idea together in some way.

Dr. WULF. Can I reinforce that? Just in my travels around the world in the last 10 years, I feel we are at a moment in time, where this kind of activity could have an enormous impact, positive impact, on U.S. foreign policy and U.S. hopes for democratizing the rest of the world. We have just got an opportunity, and it is very frustrating that we are limited in being able to take advantage of that opportunity.

Mr. EHLERS. That is very true, and you know, these things happen in a haphazard way. I had a constituent come to me a couple of years ago. They had a great idea for a new water filter. It is made out of concrete with sand in it, et cetera, and he had backing of the Rotary Club. He wanted to know what I could do for him through the government. I said, not much. But I did put him in touch with a friend who works regularly in Africa as part of our religious denomination, and then there is another friend of mine who operates a plastic extrusion plant so he replaced the concrete with plastic. He is producing these things at very low cost. Easy to ship to Africa. We are saving an incredible number of lives just with a simple, local project which results in purified water on a per-family or per-community basis. It is amazing, just a few people getting together. That is without the benefit of the Government, and maybe it is best that we don't have the government involved in it. It would increase the cost and the difficulty. But nevertheless, we are missing—as a nation we are missing all these opportunities.

Chairman BAIRD. Thank you, Dr. Ehlers. Thank you. The points you raise is really the purpose of these hearings. The whole series of hearings is to try to understand how, from many perspectives, what is being done and then see what we can do in an improved

way until this is part of that. I agree, I want to raise the profile and that is indeed why we are having this meeting.

We have now been joined by Mr. Carnahan—we mentioned earlier their role, Russ, was discussed the importance of the Foreign Relations Committee. Russ plays a central role because he has a joint assignment to both this committee and the Foreign Relations. So welcome, Mr. Carnahan. Do you have any questions for our witnesses? Recognized for five minutes.

Mr. CARNAHAN. Thank you and I apologize for being late today. I got tied up on something else, but wanted to make a special point to be here.

I guess I wanted to first start with kind of a broad question, and we may have covered some of this but as we know, the Department of State is chiefly responsible for our diplomatic relations and engagement; and I guess I would want a description from you of what their—how they are using the role of science and diplomacy now in ways that you think is working. What do you think is working best about that? And then also, what do you think is some of the obvious things that they are missing in terms of how it can be better integrated, in what they do.

Dr. LESHNER. A couple of examples immediately come to mind. One is in a partnership with the Department of State led by Paula Dobrianski. We organized a meeting on women in science and engineering and the Muslim world, and that was an extremely effective example of science diplomacy at its best where 200 women from I believe 30-some countries participated in that meeting. Recently our Chief International Officer, Vaughan Turekian, just came back from a meeting in Uruguay to start talking about some of the collaborations that an organization like AAAS might be able to help facilitate. So there are examples.

I think the issue that did come up earlier is an important one and that is the way in which these activities are initiated and maintained is critically important. And often to have a non-governmental organization as a clear partner and help lend neutrality, whatever the word is, clear motivation to it so that it is not just implementing a particular political agenda but also has scientific motivation as well.

Dr. CLEGG. I will just add a tiny bit. From actually in my written testimony was a comment on the May 2007 strategic plan that the Department of State had developed on setting international goals for their science, technology, and health diplomacy. We think those are a very good set of goals. I think our major concern is whether they have the resources and capabilities to implement them. So being able to reach out to other organizations, like those represented at this table, as partners in implementing those goals may be helpful.

The only other comment is that often the science technology capabilities at the embassy level in U.S. missions abroad is fairly limited, and that is a disadvantage. It is again a resource-driven question, but it is a disadvantage to U.S. diplomacy because it makes it more difficult for us to understand and interpret it, S&T strengths and developments in the countries that we are engaged with.

Dr. WULF. I would second the last comment that Mike made. Over the last several decades, the number of science attachés in foreign embassies has dramatically dropped. The emphasis in most of the State Department now is on political and economic issues. It is a positive thing that there now is a science advisor to the Secretary of State. We have a particularly good person, Nina Fedoroff, in that position now. But as currently structured and to some extent as currently culturally oriented, the State Department is not particularly good at implementing the kinds of things that we have been talking about this morning. That is why they use us and I think appropriately so.

Dr. CALVIN. I think the only thing I need to add on this is when I talk about the science and diplomacy, the first observation that comes to mind is always that the scientific timetable for success and the political timetable for interest often don't match. And it is a major commitment for people to reshift their careers to certain areas of emphasis and they are very hesitant to do so, given some past experiences in the high-energy physics arena, for example, to make these leaps of faith that they can't believe that their crew would be able to be supported once they make that transition.

Mr. CARNAHAN. Good point. I appreciate all of those. One thing in particular I wanted to mention that I was on a recent delegation trip that included a stop in India where they had announced a very large expansion of the Fulbright Program there, and it was done in a unique way, really opening it up to public and private funding in a way that dramatically expands what they are doing there.

And so it was a neat, kind of local initiative what they are doing right there, organized through the embassy there. That might be a good model to look at growing those kind of programs in other parts of the world. Thank you very much.

Chairman BAIRD. Mr. Bilbray.

Mr. BILBRAY. Yes, Mr. Chairman. One of the things I think we were talking about is the challenges out there, and somebody will bring it up. I think, Mr. Chairman, one of the—while we face the challenges, we need to sort of look at great opportunities. I think that we use the term worldwide web and don't think about how deep it really does run. I mean, everybody is astonished they can go to Kuwait and get on the Internet. Mr. Chairman, I think any of us that have spent time in the third world, when you go back into the villages in some of the poorest neighborhoods, some grandmother has figured out to pick up two or three old computers and the number one source of communication between countries now, in third world countries, are not telephones, not mail, it is the Internet. So I think this issue of the accessibility of third-world nations having the accessibility to the world information is something that really is a great opportunity if we can figure out how to tear those barriers down. And it has just astonished me as I travel in the third world when I get back there. If I need to communicate with my staff, I don't make phone calls, I get on the Internet and just figure out how to pay, you know, 15-whatever to a little old lady just so I can spend 15 minutes to communicate. Just let my staff know that they still have a job.

Building on that, let me just sort of go a whole different way. Dr. Calvin, we were looking at the comment on Central America. I

mean, how many Americans realize that we are 400 miles further away from San Diego where we sit now, Mr. Chairman, than where we are from Central America, that it is right in our backyard. And I would just say this to somebody on the Foreign Relations Committee—maybe the Science Committee and Foreign Relations Committee really need to get together and say the poor stepchild is Central America. We talk about South America, we talk about Mexico, but Central America is just literally a diplomatic black hole for us in so many ways. And Dr. Calvin, you have talked about Latin America. Is there any specific items that you can point out? Panama is a good example but you know, we are talking about some of the poorest people right in our back yards. It is going to have an effect on our grandchildren's future than any other. What are we doing in Central America?

Dr. CALVIN. I guess I will take a sort of the securest route to get to your answer. Our relationship with Mexico has been very effective for a couple of reasons, clearly on the proximity between Texas and Mexico is certainly an advantage. But also because of the Border Governor's Initiatives and other activities that are taking place, there is a recognition that these scientific changes can also produce economic development benefits that can help the stability of the relationship between Texas and Mexico, but Mexico has a size advantage. And when you take the relationship we have with Mexico and you talk to people—has come to visit us from Panama because they want to put a duplicate relationship together that CONACYT developed in Mexico, and the difficulty is the size of the capacity that exists in Panama or these other countries. It is very difficult to duplicate because Texas A&M University and 40 universities in Mexico. We have Texas A&M University and maybe over two or three universities in Panama, and many of them, their researchers are not really trained to be globally competitive in research and so their interests are in upgrading the capacity to be able to become partners with global environment in the competitive research arena.

So we are trying to figure out how to partner with distinct political groups in a global area because each of them doesn't really have enough capacity to work as effectively individually as Mexico.

Mr. BILBRAY. Well, that is why like last month we met with—the southern parts of Mexico have not gained from any of the exchanges. They are economic cul-de-sacs. But Central America, which was once a united country, still has its immigration policy as the United States of Central America. We need to address those comprehensively to get them used to working together, but I would be interested in the experience you had in Central America and your observations and the challenges there because we have got a whole lot of scientific research. I am overseeing Scripps Institute looking at Central America for the development of biofuels, and the infrastructure is traditionally not there but the attitude toward the United States is so positive right now, I worry about us looking to, and no offense, Mr. Chairman, looking to Africa and Asia while we overlook our neighbors. And if you could address that?

Dr. CLEGG. Well, I think you are making a very, very important point. Much of Central America is extremely poor, Guatemala, Honduras, Nicaragua. Costa Rica is a bit better, and the question

is why does Costa Rica stand out, and the reason is that they have invested a lot more in education and tried to build an economy focused on the comparative advantages that Costa Rica has, particularly in the environmental context. But in Nicaragua for example, 50 percent of the population is illiterate. I have had experiences in Guatemala, El Salvador, and Nicaragua in my duties representing the Academy. One of the things that is going to be key for them to move forward in their own development is to make more investments in education. But those to some extent are local responsibilities. There are things that we can help with by providing incentives, but there are not things we can do for them.

Mr. BILBRAY. Thank you, Mr. Chairman.

Dr. WULF. Can I just add something here? This is about Venezuela which is not quite Central America but almost. I had a fascinating experience in January. I was privileged to be inducted into the National Academy of Sciences in Venezuela. I went down there with some trepidation given the bellicose tone of exchanges between our two governments, and what I found was exactly what we are talking about in this hearing, namely the ability of scientists and engineers, because of their shared values, because of their frequent training in the United States to communicate. I think we have an enormous opportunity to turn the situation around with Venezuela and the opening is through scientists and engineers. I think this is globally true, but it was just such a forceful, personal experience.

Mr. BILBRAY. Well, historically in Latin America, Academia as a whole has not been politically threatened, and so the political structure has allowed academia to do trans-border communication that traditionally they would not allow any other institution to do. So we do have the opportunity if they are willing to allow academia and scientists to cooperate and work without direct supervision by government, where other institutions would not be allowed to do it.

Dr. WULF. And this is a perfect example of where using NGOs doesn't introduce the complication of government-to-government interaction.

Dr. CLEGG. Just to follow up, I just returned from a meeting of the network of Academies of Science in this hemisphere which was held in Central America this weekend. We have a very effective organization that could do much, much more in that network of science academies; and it tries to address three questions. One is the problem of education in the hemisphere, the second is water resource issues in the hemisphere. So we have the means to do much more. We have built the relationships. We also command respect among our peers in that part of the world because we have tried to work together with them. But what we are able to do at the moment is limited once again by our resource capabilities.

Chairman BAIRD. Thank you, Mr. Bilbray. I think your points are well-taken about relative neglect of our own hemisphere. I know well, having flown to Guatemala once and I get off the airplane, I thought I would be back home in Vancouver, Washington, yet I am already in Guatemala. We forget that.

I thank the witnesses for not only your outstanding and insightful testimony, both verbal and written today, but your many years of service, each and every one of you. The record of this committee

will remain open for additional statements from Members and for answers to any follow-up questions. We thank the witnesses, the audience and the Members of the Committee, and with that, the hearing stands adjourned. Thank you very much.

[Whereupon, at 11:51 a.m., the Subcommittee was adjourned.]

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